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ABSTRACT

A study tested hypotheses concerning thinking in a foreign language. Specifically, it looked at whether (1) inferencing in a foreign language relies on mental models and propositional thinking; (2) the three stages of the theory of comprehension apply to understanding foreign-language discourse; and (3) propositional thinking manifests native language influence. The subjects were Finnish secondary school students with nine years of English language training. The study analyzed false responses to a cloze test to examine the processes underlying them. Results supported all three hypotheses, but the cloze procedure was found to be a limited tool for measuring comprehension. (MSE)

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RESEARCH REPORT 44

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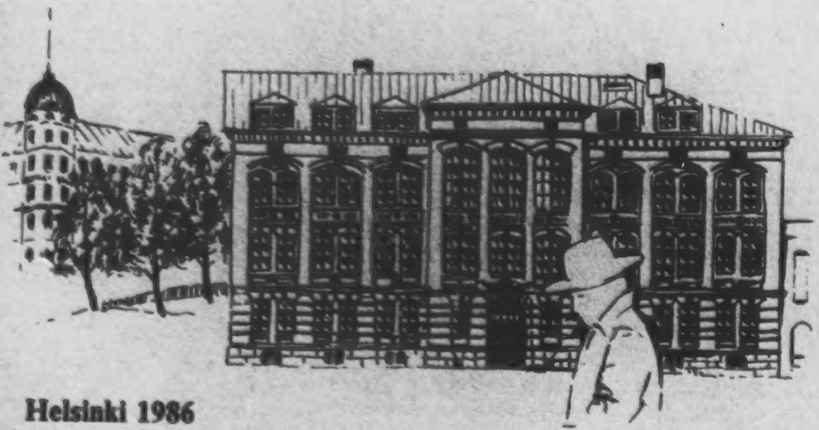
Paul Hellgren

THINKING IN A FOREIGN LANGUAGE



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Paul Hellgren

THINKING IN A FOREIGN LANGUAGE

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Paul Hellgren
Thinking in a foreign language.
134 pp.

Summary

The aim of the study was to investigate the question of whether thinking in a foreign language is possible from the perspective of psychological processes. The problem was analyzed within the framework of P.N. Johnson-Laird's theory of mental models, which elucidates reasoning in natural language without mental logic. This concerns itself with the questions of how meaning is represented psychologically and of how the different types of mental representations serve as a basis for comprehending discourse. From that theoretical background, an attempt was made to develop an account of thinking in a foreign language. The results were then corroborated by findings in the research literature concerning the relationship between cognition and language acquisition, and foreign language learning and acquisition.

The conclusions drawn about thinking in a foreign language were that people do not think in words or at linguistic level at all. In using a foreign language, speakers make inferences and think by constructing mental models that do not encode linguistic material. They have acquired models in using their mother tongue. If specified or modified models are employed, it is a matter of proficiency rather than an inherent part of natural thinking. Propositional thinking is nearer the surface level, but it is thinking in pure meanings, influenced by the native language. In practice, thinking in a foreign language is intimately related to proficiency. If a person has acquired fluency and automaticity in the use of the language, he may be capable of near-native performance and functioning accordingly, without, strictly speaking, thinking in the foreign language.

The empirical study focussed on analyzing the data obtained from correct and erroneous cloze test responses by advanced English learners (N=498). The aim was to find empirical corroboration for the theoretical development of reasoning through mental models and propositional thinking as well as for the three-stage theory of comprehension. The findings supported them.

Keywords: thinking, foreign language, mental models, propositional representation, cloze

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Paul Hellgren

Ajatteleminen vieraskielellä
134 s.

Tiivistelmä

Tavoitteena oli tutkia sitä, onko psykologiselta kannalta mahdollista ajatella vieraskielellä. P.N. Johnson-Lairdin teoriaa psyykkisistä malleista (mental models) hyödynnettiin ongelman erittelemiseksi. Teoria selittää kieleen pohjaavaa päättelyä olettamatta mielen sisäistä logiikkaa. Ongelma liittyy kysymyksiin siitä, miten merkitys ilmenee psyykkisesti ja miten erityyppiset representaatiot toimivat puheen ymmärtämisessä. Tältä teoriapohjalta pyrittiin selvittelemään ajattelemista vieraskielellä. Erittelyn tueksi tarkasteltiin tutkimuskirjallisuutta, joissa on selvitelty kognition ja kielen omaksumisen samoin kuin vieraskielen oppimisen ja omaksumisen välisiä yhteyksiä.

Tutkimustulokseksi saatiin, että ihmiset eivät ajattele sanoin eivätkä kielellisellä tasolla ylipäätään. Käyttäessään vieraskieltä puhujat päättelevät ja ajattelevat konstruoimalla psyykkisiä malleja, jotka eivät sisällä kielellistä ainesta. Mallit on omaksuttu äidinkielen käytössä. Jos vieraskielen käytössä tarvitaan eriytyneitä tai modifioituja malleja, kyseessä on opittu taito eikä niinkään luonnolliselle ajattelulle ominainen piirre. Propositionaalisesti ajatellaan lähempänä kielellistä pintatasoa, joskin pelkkien merkitysten avulla, jotka ovat saaneet vaikutteita äidinkielestä. Käytännössä ajatteleminen vieraskielellä liittyy läheisesti kielitaitoon. Sujuvassa ja automaattisessa kielenkäytössä saatetaan päästä lähes syntyperäisen kielenpuhujan tasolle toiminnallisesti, vaikkei silloinkaan voida puhua varsinaisesta ajattelemisesta vieraskielellä.

Empiirisessä tutkimuksessa analysoitiin lukion kolmasluokkalaisten oikeita ja vääriä vastauksia englanninkielisessä cloze-testissä (N=498). Pyrkimyksenä oli selvittää, tukivatko havainnot teoreettista kehittelyä siitä, että vieraskielen puhujat päättelevät psyykkisten mallien avulla ja ajattelevat propositionaalisesti kolmivaiheisen ymmärtämisen teorian mukaisesti. Tulokset olivat oletusten mukaisia.

Avainsanat: ajatteleminen, vieraskieli, psyykkinen malli,
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1. Introducing the subject

Thinking is certainly the most natural and characteristic human mental activity. It is an inexhaustible source of thought and inspiration, but an inaccessible object of study to the eye. Its products are seen as innumerable realizations, but its functions are dimly known. Its origin is hard to explain, but its manifestations in everyday life are commonplace. Thinking in all its emergent modes is a vast object of study. However, through a choice of verbal thinking its scope will be confined somewhat. The relationship between language and thought is at issue, but the question becomes even more problematic when the language is a foreign language. Is it possible to think in a foreign language? If so, how is it done?

Many people believe that it is possible to think in a foreign language, and many people claim that they do. If the claim that language and thought are interwoven and interdependent, the question arises of whether it is possible to think in another language or of whether it is done through the native language. On the other hand, the standpoint that language and thought are separated raises the question of the existence of a mental logic that functions irrespective of language. How is it otherwise possible to understand another language? If the foreign-language meanings are directly compared to the native-language meanings, this mapping must be explained by some cognitive functions.

Observations and experience show that, in using a foreign language, people make such errors that seem to be caused and influenced by the native-language meanings and expressions. Also, people from different linguistic backgrounds do not make completely similar errors in speaking a particular foreign language. This would indicate that the foreign language is somehow linked to the native language. It does not necessarily follow that the link is a factual dependence. It may only be a strategy of coping with a situation when the knowledge of the foreign language is deficient: help is sought from the native language. On the other hand, bilinguals often claim that they can switch from one language to another so easily that there is no difference which language they speak. This group includes so-called balanced bilinguals who master the foreign language at a native or near-native level.

It is not only interesting but also important to know if and how people can think in a foreign language. The answer has implications for our understanding of the relationship between language and thought and of human mental processes in general. More specifically, the results must be viewed in terms of our conceptions of foreign language acquisition and learning. This cannot but influence our conceptions of foreign language teaching, and also, the practice of how it is done, if needed. All those who have experience of learning and acquiring foreign languages, and experience of using them in communication may have formed an opinion and even hold a conviction of the matter. Nevertheless, introspection in writing these lines does not even give a clear, let alone reliable, answer. A more scientific approach is called for.

2. The aim and purpose of this study

Thinking can be viewed and studied from different perspectives. Accordingly, we may make distinctions among different modes of thinking that are relevant for our purposes. One fundamental distinction may be drawn between the contents of thinking and the thinking processes. In this study, my aim is to investigate verbal thinking in terms of language that is foreign. Therefore, it is clear that my focus is on the mental processes that operate in the use of foreign language. In contrast to such psychological research that investigates thinking in terms of problem solving, my interest is in the natural inferencing that is made in comprehending natural language, and partly, in the monitoring that is called for in producing speech. I do not deny that communicating in a foreign language may sometimes appear as problem solving, but the aim is not to study artificially set problems to which subjects have to find novel solutions.

Thinking in a foreign language has become commonplace in the Soviet methodological tradition, so that the question takes the form: How can one make foreign language teaching as creative as possible and introduce elements of intellectual activity into the learning activity ? This is how B.V. Belyayev attempted to answer the question. He proposed that teaching should be constructed in such a way that language is used not only for communication purposes (above all, not only in mechanical, non-communicative speech), but as a medium which will engage the thought, perception, and imagination of the learner. (Leontiev 1981, 65.) The methodological point is important in terms of teaching, but the present study aims at elucidating the problem from a psychological and psycholinguistic perspective.

The following two research questions can be asked although they are ambiguous and interrelated:

1. Is thinking in a foreign language possible?
2. How is thinking in a foreign language possible?

The first question may suggest that the problem is of a conceptual nature. Only the answer "yes" would then imply the second question. To me, the answer "no" also implies the second question, because in such a case we should be able to show that it is impossible to think in a foreign language, and if we cannot do that, we can at least try to qualify the possibility. Thus, either answer implicates the second question. I use this Brouwerian criticism against the law of the excluded middle to explain that my attempt is to answer the questions within the tradition of empirical research. Therefore, it is quite possible to arrive at a solution which is not a simple yes or no.

Although a problem may be simple to set, its solution is hard to find and complex to present. I shall take advantage of the theory of mental models developed by P. N. Johnson-Laird in order to elucidate how reasoning is possible in natural language without a mental logic. This involves the questions of how psychological meaning can be represented and how the different types of mental representations serve as a basis for comprehending discourse. From that theoretical framework, I shall attempt to develop an account of thinking in a foreign language. Besides the permeating question of the relation between language and thought, learning and acquiring a foreign language become important factors in terms of thinking. In the study of thinking as problem solving, the influence of learning is at issue, but in foreign language processing, the question of general processes and the specific strategies generated by the foreign language use become an important object of study.

On the basis of the empirical data obtained from cloze test responses by advanced English learners, I shall test some of the hypotheses behind the conception of thinking in a foreign language. In a sense, it is an attempt to find empirical corroboration for the theory of mental models, by using a foreign language as a medium. I hope the answers to the research problems and the conclusions to be drawn from the empirical data will benefit the development of a foreign language learning theory, although it is not the aim of this study. The results are likely to have implications for foreign language teaching as well.

A few words must be said about terms in this study. A variety of expressions are used in the research tradition of non-native languages. Some scholars make certain distinctions, and if they are not explained, confusions may arise. In this study a 'foreign' language refers to any non-native language that is learnt or acquired after the primary language. 'Foreign' is interpreted in terms of the individual, and no theoretical value or societal fact is attributed to it. Some others prefer the term 'a second language', but I use it interchangeably, depending on the source. Between the terms of acquisition and learning, I do not draw the distinction of unconscious and conscious processes, because it limits language use irrelevantly. Rather, the distinction lies in the degree of automaticity, so that what is acquired is internalized more profoundly. There are other terms which are used with various meanings in the literature, but I think the meaning will become clear in the context.

3. The relation between language and thinking

Much has been written about the relationship between language and thinking by psychologists, linguists and philosophers. The ontological problem concerns the question of whether thinking precedes language or language precedes thinking. The ontological order may refer to phylogenetic, ontogenetic or causal order. The difference in the standpoints is usually based on opposing theories of language acquisition. The matter at issue is whether language acquisition presupposes thinking or whether it is language acquisition that enables thinking. (Taiminen 1981.)

The ontological priority of thinking has been supported by such philosophers as Aristotle, Augustinus and Descartes and by the linguists Chomsky and Katz and by the psychologist Jean Piaget. The opposite standpoint that language ontologically precedes thinking has been represented by such philosophers as Wittgenstein and Quine, by such linguists as Humboldt, Sapir and Whorf and by psychologists such as the behaviourists. (Taiminen 1981.)

Psychologists have usually emphasized the importance of language in forming and shaping thought. Since behaviourists believed that language was acquired as a series of habits, they could easily explain the origin of thought as the accumulation of various combinations of verbal stimuli, that is, of words and language structure. This view is, however, easy to refute, for example, by the common observation that the deaf, even those who have had no language training in another sensory modality, are capable of thinking (Cromer 1976).

A second influential school of thought came from anthropological linguistics, which emphasized the importance of language on the thought processes. The two advocates of this view were Edward Sapir and Benjamin Lee Whorf, who independently put forward the thesis that may be called the Sapir-Whorf hypothesis. It asserts that one's native language directly determines major aspects of thought. Some scholars have attacked this extreme position by claiming that the speakers of one language are able to understand the concepts that the speakers of another language express easily and take for granted. It may be that more words are needed to express them, but it can be done.

Brown (1956) suggested that languages differ in the ease with which they code various concepts. If the language possesses a concept, it is naturally more readily available for use by the speaker of that language. For example, the Eskimos have several different words for different kinds of snow because the distinctions are important in their everyday life. Brown argues that language does not determine our thoughts, but only predisposes us to think in a particular way. This view is known as the weak form of the Sapir-Whorf hypothesis.

Theoretical linguistics offers a third influential source that emphasizes the importance of language. This influence comes from Chomsky's writings (1957, 1965). He proposed that the process of native language acquisition is guided by an innate "language acquisition device" (LAD) containing knowledge of language universals. Since these mechanisms are innate, they are also found universally. Although general cognitive and perceptual strategies may play their part in the acquisition process, it is assumed that some strategies at least are purely linguistic. He has many supporters among mentalist psycholinguists. On the other hand, many have disagreed with this view. Slobin (1973), for example, considered that language acquisition resulted from special capacities that were the outcome of general cognitive development, and not innate. Hammerly (1982, 88) seems to abandon the nativist view abruptly, by claiming that there is not an iota of evidence of an LAD. He condemns particularly the assumption of hypothesis testing as the only way of acquiring language. The child's ability to discriminate and generalize is ignored, together with experience with his environment.

The question of the link between language and thought is related to how the ability to reason is acquired. Piagetian theorists have assumed that children think very differently from the way adults do, whereas nativists postulate an innate logical ability. Among them, Fodor (1975) has strongly argued for the impossibility of any theory to account for the beginning of learning concepts inductively because learning concepts presupposes the mastery of concepts. Passing from one developmental stage to another cannot take place because the more developed stage presupposes a more powerful logic than the the preceding one. Therefore, Fodor concludes with the claim that no concepts are invented, they are innate.

Johnson-Laird argues that it is ambiguous to claim that there is no way in which the logical power of the mind could be increased by learning. He shows that any computable function can be characterized in terms of the three sorts of primitive recursive functions (the zero, identity, and successor functions) and the three operations that create new functions out of old (composition, recursion, and minimization). Hence, any computable procedure can be constructed out of these functions. (Johnson-Laird 1983, Ch. 1.) Learning can be thought of as a procedure that discovers a way in which to combine old functions so as to create new ones. "The system starts with an inborn set of functions and an inborn set of procedures for combining them, and learning consists in constructing functions that the system did not hitherto possess out of the functions that it did possess. There is accordingly both a sense in which the system does not increase in power — it always had the power of a Universal Turing machine — and another sense in which it *does* increase in power — hitherto it was unable, say, to make a transitive inference, but now it can do so." (Johnson-Laird 1983, 143.)

The above shows that it is not necessary to accept Fodor's conclusion. Stage one need not be weaker in computational power than stage two. In stage one, a person has a weaker logic but possesses the capacity to construct a more powerful logic. A second point is that what is learnt must not be confused with how it is learnt. All that can be learnt is not the inductive confirmation, or disconfirmation, of a belief, because otherwise, we can never learn necessary truths. (Johnson-Laird 1983, 143.) Nevertheless, nativism cannot completely be abandoned because there must be an innate armamentarium of data and procedures. Johnson-Laird admits that stages in inferential ability cannot possibly be associated solely with mental logics of increasing power, just as Fodor argues. However, Fodor must be wrong in his claim that all concepts are innate and that inferential skill cannot be learnt.

The issue between language and thinking cannot perhaps be resolved in any one discipline by concentrating on a single aspect of the problem. Thus, investigations into language and its nature have proved inadequate and psychological research has been utilized to get some empirical evidence of the psychological reality of language. Generally speaking, attempts have been made to find a solution on a multidisciplinary basis. In recent psychology, the problem centres on the question of the relationship between cognition and language, as reflected in the different views of language use and language acquisition.

Philosophers also speak of epistemological or conceptual order. In principle there are two ways of answering the question of how we gain knowledge about thinking and of how we understand mental activities. The Cartesian tradition relies on introspection: we may know about thinking without referring to external public objects or actions. Concepts about thinking are then transferred to apply to external spoken language. The opposite standpoint, the so-called Aristotelian tradition, claims that we primarily have knowledge about external public objects, events and actions. The category of intentionality, for example, is primarily applied to language and secondarily to thinking. When such concepts are used of thinking, they can be regarded as analogous extensions of the original concepts. Delaney (1979) calls the Cartesian tradition internal and the latter external.

A theory which Sellars (1963) calls the analogy theory of 5 thinking has been traditional ever since Plato and is vastly accepted within the external tradition. It claims that thinking functions in analogue with speech, and the analogue is based on the conceptual or semantic role, in particular (see for example Tuomela 1977, ch. 3, Taiminen 1981). Thus, a person's utterance 'That is a new car' is assumed to have the same role in his speech system as his thinking episode 'That is a new car' has in his thinking system. More generally speaking, this analogy theory falls under the functionalist theory, which conceptually starts from the assumption that public rational actions like speech are fairly easy to understand. Since such actions also embrace social action, it can be claimed that the conceptual basis of the analogy theory about cognitive mental processes is social practice. From this the analogy theory construes cognitive processes into a kind of theoretical episodes. (Tuomela 1983, 18.)

Even though thinking and speech are similar in structure, they are not, however, quite identical. Speech is seen conceptually to precede thinking. What knowledge we have of thinking is indirectly gained through speech, which may serve as a model for acquiring knowledge of thinking. Sellars claims that his analogy theory of thinking is in harmony with the view that ability to think is acquired in learning language (1956, 319). The theory also harmonizes with the thought that there exist non-linguistic representational activities (1980, 15).

In the analogy theory, the intentionality of cognitive processes (the fact that man can think of non-existent things, such as the future) is construed on the basis of the intentionality of the corresponding language use. It claims that intentionality can be fully accounted for by the so-called semantic categories of meaning, reference, and truth, for example. Thus reference and truth do not express two-place relations between a particular linguistic entity and the corresponding entity in the world. The semantic terms 'referring', 'meaning' and 'true' categorize expressions and give the meaning of the use; meanings are categories of the language use, i.e. linguistic roles. (Tuomela 1983, 18, 29.)

If we accept the functionalist account, the problem of ontology can be left aside. This enables us to introduce epistemic concepts functionally. They rely on language practice or social practice but are determined by the theories in which they are employed. Such functionalism does not force one to make ontological assumptions as to which is prior, thinking or language, for example, because the concepts get their meanings in the semantic discourse that is used of the mental or social phenomena.

In analogy to philosophical considerations, we may note that the doctrine of functionalism also works in the empirical sciences where the mind can be studied independently of the brain. Using a metaphorical analogy between the human mind and a computer we may talk of a programme that a computer carries out and the codes that different computers have, i.e. the same programme computes the same function however it is physically realized. What this means for psychology is that the study of the programmes can be pursued independently of neurophysiology that studies the machine and the machine code. The neurophysiological substrate provides a physical basis for processes of the mind. Given that the substrate offers the computational power of recursive functions, its physical nature places no constraints on the patterns of thought. (Johnson-Laird 1983, 9.)

Even though all theories are abstractions, there is a more intimate relation between a programme modelling the mind and the process that is modelled. "Functionalism implies that our understanding of the mind will not be further improved by going beyond the level of mental processes. The functional organization of mental processes can be characterized in terms of effective procedures, since the mind's ability to construct working models is a computational process. If functionalism is correct, it follows not only that scientific theories of mentality can be simulated by computer programs, but also that in principle mentality can be embodied within an appropriately programmed computer: computers can think because thinking is a computational process." (Johnson-Laird 1983, 9-10.)

In this research, we shall study thinking within the framework of the external tradition, that is, we shall regard language as the public object which we may get some knowledge of. Since the intentionality is expressed in the language, theoretical concepts may be constructed on the basis of reference, meaning, and truth. The procedure of introducing theoretical concepts on the basis of semantic categories will fall within the functionalist approach of philosophical investigations. The psychological reality must be investigated empirically. If the theoretical concepts are introduced functionally, the programme will become hypothesizing about psychological processes. Although the microlevel cannot be predicted from them, it must, however, be assumed that the microlevel is capable of carrying out the processes in reality. When this requirement is fulfilled, it is possible to construct theories of psychological processes.

4. Mental models

4.1. Mental logic

If we accept the analogy theory of thinking, we may avoid the problem of which precedes, thinking or language, but we still face the problem of how non-linguistic cognition is linked to language in the thinking process. Thinking in the sense of reasoning is a central ability of human mentality. Many occasions in life call for inferential skill, such as deciding on courses of action, evaluating assumptions and hypotheses, weighing evidence, solving problems, and developing science, culture, and technology.

Inferential thinking is not easy to define, because it depends on the theory within which it is employed. Since we are going to make use of Johnson-Laird's theoretical development, let us content ourselves with his working definition: "An *inference* is a process of thought that leads from one set of propositions to another. Typically, it proceeds from several premises to a single conclusion, though sometimes it may be an immediate step from a single premise to a conclusion. The propositions are usually expressed verbally, though in the case of some practical inferences the premises may consist of a perceived or imagined state of affairs and the conclusion may consist of a course of action. The process of thought in a *deduction*, ..., is based on principles designed to establish a logical relation between the premises and the conclusion." (Johnson-Laird 1983, 23-24)

This study attempts to elucidate reasoning that is based on verbal material and that goes on in people's heads when they use language in communicating with each other. This leads us to account for the mental processes that occur in deductive inference. Although we focus on inferences made on the basis of the linguistic material, the question arises of whether the knowledge of the syntactic structure and the semantic interpretation of sentences alone are enough to explain the process of valid reasoning.

In order to solve the problem of how people can reason validly, psychologists have postulated that there is a logic in the mind. Inhelder and Piaget (1958, 305) represents an extreme form of this idea of a mental logic: "Reasoning is nothing more than the propositional calculus itself." Even though most versions of the doctrine are less extreme, it is fairly widely accepted that rational thought presupposes the laws of logic. This poses the question of where mental logic comes from. It has been claimed that it is impossible for a child to learn logic if he is not capable of reasoning validly. But if he can do that, there is no point in learning logic. The development of logic is frequently linked to learning language. As children learn language, they acquire grammatical rules. Likewise, they are assumed to abstract rules of inferences. The consideration of these issues has led some psychologists, Fodor (1975) for example, to argue for an extreme nativist position, which claims that logical competence is not acquired, but is innate.

Piaget does not utilize the conventional principles of learning theory or innate structures to account for the development of logical thinking. According to him, children derive their own mental structures from their interactions with their environment. They construct logic by internalizing their own actions and by reflecting upon them. The mastery of propositional thinking ultimately grows from the mental operations that "concern transformations of reality by means of internalized actions that are grouped into coherent, reversible systems" (Piaget and Inhelder 1969, 93).

Johnson-Laird (1983, 25), however, sees the relation between Piaget's theory and his observations as problematical, because Piaget has never described the developmental process in a form that constitutes an effective procedure. This concept has been adopted from the theory of computability. If a procedure can be carried out by a simple machine, plainly it does not require any decisions to be made on the basis of intuition: it is then an effective procedure. Johnson-Laird wants to see the theory expressed in such a form, but as a general criterion it is intended to apply to all scientific theories.

Whether we accept Johnson-Laird's critique or not, there are several other problems connected with the doctrine of mental logic, which restrict its adequacy. Therefore, mental logic needs some adjustments in order to meet the empiral challenges that have been observed. The main problems are:

1. People make fallacious inferences. If there is mental logic, this cannot be done.
2. There is no definitive answer to which logic, or logics, are to be found in the mind. Psychologists have postulated mental counterparts to certain calculi of modern logic, but they have failed to corroborate such assumptions empirically.
3. The third problem concerns the formulation of logic in the mind, which is connected with propositional reasoning. Schemes of natural deduction have been suggested, but direct empirioal evidence has not been obtained.
4. The question of how a system of logic arises in the mind is at issue. No adequate answer has been given so far.
5. Empirical evidence suggests that people's deductions are not immune to the content of the premises. When individuals have a relevant mental model of a relation, they are more likely to reason about it validly.
6. It has been observed that people follow extralogical heuristics when they make spontaneous inferences. They seem to be guided by the principle of maintaining the semantic content of the premises but expressing it with greater linguistic economy. This can be considered an intrinsic part of the mental machinery for inference. (Johnson-Laird 1983, 39-40.)

These problems appear to give good arguments against an infallible mental logic. However, Johnson-Laird is prudent to draw any definitive conclusions even though he notifies the above issues. Thus, he does not attempt to refute the doctrine of mental logic or to deny the thesis that human beings are capable of rational thought. What he wishes to argue for is that there can be valid reasoning without logic, and that in place of mental rules for inference, he can develop a theory of the inferential mechanism from which certain heuristic principles are an automatic consequence. That is what he calls a theory of mental models.

4.2. Inference and mental models

An important distinction may be drawn between two sorts of inference. When people have to make a conscious decision to try to make inferences, they become engaged in explicit reasoning. Inferences that underlie the processes of intuitive judgment and the comprehension of discourse are commonly rapid, effortless and outside conscious awareness, and therefore implicit. Theories of thinking have usually been based on explicit, rather than on implicit reasoning, until attempts to program computers to understand discourse have revealed the negligence.

If people are not able to make implicit inferences, it is hardly possible for them to understand written or spoken discourse. Whatever text we read or listen to, we must necessarily make a variety of inferences. We must, however, make the inferences at a point at which we cannot securely establish them. That makes our inferences into plausible conjectures, rather than into valid deductions. This hypothetical nature of inferences has led many psychologists to assume that people compute probabilites in reasoning.

It is hard to accept the assumption that people compute probabilities. Johnson-Laird proposes that the mechanism is more likely to consist of a device that constructs a *single* mental model on the basis of the discourse, its context, and background knowledge. Such knowledge is embodied in the model by default, which means that it is maintained in the model provided that there is no subsequent evidence to overrule it. Since reasoning does not presuppose constructing alternative models, unless such evidence arises, the process is very rapid and almost automatic. Nevertheless, relying on a single mental representation at any one time makes implicit inferences lack the guarantee, the mental imprimatur, which is associated with explicit deductions. Hence, the fundamental distinction between the two types of inference is based on the need of a deliberate search for alternative models of the discourse. (Johnson-Laird 1983, 128.)

Logical thinking in daily life is most likely to occur in explicit inferences. From a semantic standpoint, we can think of logic as a set of procedures for establishing the validity of a given inference. Logic then serves as a method for showing systematically that no interpretation of the premises is consistent with the denial of the conclusion. From a formal or syntactic standpoint, a logic contains a set of rules of inference, or inferential schemata, that allow conclusions to be formally derived from premises. Johnson-Laird's theory of mental models accounts for explicit inferences without reliance on rules of inference, inferential schemata, or any other sort of machinery corresponding to a logical calculus. Therefore, there is no necessity to postulate a logic in the mind.

In explicit inferences, human reasoners can construct finite models of premises, formulate putative conclusions on the basis of them, and search for models of the premises that are counter-examples to such conclusions. A systematic and exhaustive search produces a valid conclusion. In practice, people do not, however, perform so well. Their performance is deteriorated by their limited working memories as well as by their lack of secure principles for deriving conclusions. In brief, they lack a logic. In experimental studies, even the most intelligent individuals have difficulty with certain syllogisms. When they become aware of their difficulty, they try to externalize and to systematize the search for counter-examples, which shows that logic is used as an intellectual tool. (Johnson-Laird 1983, 133.)

The reader may wonder whether other forms of representation such as Euler circles, Venn diagrams or first-order predicate calculus can cope with the same as mental models. Johnson-Laird discusses the question. Natural mental models can represent the content of any sentences for which the truth conditions are known. This is so because the structures of mental models are identical to the structures of the states of affairs, whether perceived or conceived, that the models represent. Truth tables, Euler circles and Venn diagrams, however, have structures that are not identical to the states of affairs they represent.

Johnson-Laird (1983, 134-142) shows the advantage that mental models have over the above sophisticated forms. For example, the formal properties of such relation expressions as *more than, taller than, bigger than, kinder than* and their cognates are not enough to distinguish the differences in meaning between them. Their semantics must also be taken into account. The logical properties of a relation then emerge naturally from its meaning. If natural language contains terms with an implicit 'logic' that is so powerful that it cannot be completely emcompassed by formal rules of inference, i.e., there is no formal logic that captures all the valid deductions, then *a fortiori* there can be no mental logic that does either. Hence, we may agree with Johnson-Laird and conclude that it is wise to give up the doctrine of mental logic.

Mental models are said to represent the states of affairs as they are. If they are not pictures or images, their representation must be only structural and relational. This cannot obviously be interpreted as a purely formal representation because some meaning is involved, as Johnson-Laird's argumentation showed. In other words, mental models include some substance as well. If we assume that mental models are basically free from the influence of a particular language, the content aspect involved in them raises the question of what type of information it is and of whether mental models are universal in their contents or dependent on cultural factors.

All in all, Johnson-Laird outlines a general theory of inference, which is based on mental models. His theory accounts for both implicit and explicit inferences. Implicit inferences depend on constructing a single mental model whereas explicit inferences depend on searching for alternative models that may falsify putative conclusions. Also, the theory is compatible with the fact that human beings are capable of making valid deductions. People make inferences without recourse to a mental logic; a difficulty to make inferences motivates them to search for systematic principles governing validity.

Since we investigate verbal thinking, we may note that implicit inferencing is most likely to occur in the natural use of one's native language. Explicit inferencing also manifests itself in daily life, but our concern is not a conscious way of solving problems through thinking. However, we are going to face it when we study thinking in a foreign language. A deficient proficiency in a foreign language is likely to generate a search for alternative models even in the natural use of the foreign language.

5. Different types of representation

If we accept the analogy that the human mind can be described as a computer and its programming, we may understand why the physical system may employ only strings of symbols and yet produce different kinds of functions which cannot be predicted from the code of symbols. Similarly, a psychological process may use only strings of symbols at one level, but various sorts of representation at a higher level. Such mental representations may differ in their intrinsic properties, like their structure or content, and also, in the function that they serve. The significance of a mental representation depends on the processes that construct and interpret it. Based on these assumptions, Johnson-Laird presents his thesis that different kinds of representation are logically distinguishable at some level of analysis, and that they exist as different options for encoding information. Accordingly, he attempts to show that such mental functions as mental models, propositional representations and images can be distinguished from each other.

Philosophers have generally taken propositions to be the conscious objects of thought, which are expressed by sentences. A propositional representation is then a mental representation of a verbally expressible proposition, which is true or not true of the states of affairs it refers to. Thus, a propositional representation is the representation of a function from states of affairs to truth values. (Johnson-Laird 1983, 155.) To represent a function is to express it in a language. Not only Johnson-Laird, but also others, like Kintsch (1974) and Fodor (1975), have claimed that such a mental language must have a vocabulary, a grammar and a semantics. Its vocabulary must relate to that of natural language. Its grammar must have evolved as a result of many unknown factors, but essentially, its syntax can be treated as an arbitrary choice (Johnson-Laird 1983, 156).

In current research of cognitive psychology, there occur interpretations which take the view that information is represented in terms of propositions and thus meaning is propositionally represented in memory. This propositional analysis is carried out within computer programming, where propositional representations are reduced to strings of symbols from a finite alphabet. The idea has been incorporated into such contemporary theories as Anderson (1976), Anderson and Bower (1973), Kintsch (1974) and Norman and Rumelhart (1975). Nevertheless, we stick to the common philosophical interpretation in order to avoid confusions about the meaning of the term, apart from the occasion when the other interpretation is specifically intended. Although Johnson-Laird here refers somewhat vaguely to a mental language related to the natural language, he seems to think that, as a matter of fact, it is essentially the same. The grammar of a mental language is, in principle, arbitrary, but as a mental system, it cannot be considered arbitrary, because it must be related to the particular natural language that an individual has acquired as his mother tongue.

The crucial problem for the mental language is the nature of its semantics. Propositions can refer to the world. Nevertheless, since perception is the construction of a model of the world, human beings possess only an internal representation of it. Propositions can also refer to imaginary or hypothetical worlds. One proposition may not be true of such a world given that others are true of it. Human beings can evidently construct mental models by acts of imagination and can relate propositions to such models. Thus, a principal assumption in Johnson-Laird's theory is that the semantics of the mental language maps propositional representations into mental models of real or imaginary worlds: *propositional representations are interpreted with respect to mental models.* (Johnson-Laird 1983, 156.)

Johnson-Laird's characterization of mental models suggests that they originate from human perception. Then, models should, in principle, be universal in character, and not dependent on a particular natural language. This impression is strengthened by the interpretation process. The mental models serve as a criterion of truth. The possibility of imagining hypothetical worlds seems to me to imply that the basic structural and relational system in mental models has something of a formal character, because a strict imitation of the external world as perceived gives a fairly detailed inner representation. Reliance on such a representation would perhaps cause difficulty in imagining a hypothetical world that markedly differs from the external world. Consequently, the state of affairs in mental models are, after all, somewhat condensed in richness.

The last point can further be elucidated if one compares propositional representation and mental models. Contrary to a propositional representation, a mental model does not possess an arbitrarily chosen syntactic structure, but directly corresponds to the state of affairs in the world, as we perceive or conceive it. This does not, however, prevent the analogical structure of mental models from varying considerably: "Models of quantified assertions may introduce only a minimal degree of analogical structure, such as the use of separate elements to stand for individuals. Alternatively, models of spatial layouts such as a maze may be two- or three-dimensional; they may be dynamic and represent a sequence of events; they may take on an even higher number of dimensions in the case of certain gifted individuals. One advantage of their dimensional structure is that they can be constructed, and manipulated, in ways that can be controlled by dimensional variables." (Johnson-Laird 1983, 156-157.)

The above description constrains mental models to some extent but leaves a number of structural features unspecified. This is natural because the structural properties are generic on the one hand, and specific on the other. What elements mental models ultimately consist of remains an open question. Johnson-Laird bases his characterization on their origin. It may be assumed that mental models owe their origin to the evolution of perceptual ability in organisms with nervous systems. Here Johnson-Laird relies on a computational theory of vision outlined by David Marr (1982) and his colleagues which largely accounts for the derivation of perceptually based models of the world. We may regard interpreting language and making inferences as natural extensions of mental models: if the perception is model-based, discourse about the world must also be model-based, and the ability to make inferences from what we perceive or from what we are told enables us to anticipate even quite remote events. Likewise, it is possible for us to interpret discourse about fictitious or imaginary worlds by building models of the states of affairs it describes, thus freeing us from the constraints of perceptual reality. (Johnson-Laird 1983, 407.)

The last point is what I took up earlier to give evidence of the mental models being higher-order mental processes which do not directly represent the external world. There is actually another concept 'image' which competes with a mental model as a mental representation. Johnson-Laird, however, distinguishes mental models from images, but assumes that there is a relation between them. Images correspond to *views* of models: as a result of perception or imagination, they represent the perceptible features of the corresponding real-word objects. In imagining a rotating object, for example, the underlying mental model of the object is used to recover a representation of its surfaces, reflectances, and so forth. (Johnson-Laird 1983, 157.) Here Johnson-Laird's argument relies on David Marr's (1982) concept of the'2 1/2-D sketch', which he used in reference to the process of perception. Thus, in forming an image, the person must compute the projective relations from the model to the 2 1/2-D sketch. Consequently, a model underlies an image.

What characteristically distinguishes the different types of representation is their specificity. Stenning (1978) defines a specificity as a property of representation systems, so that a representation system is specific with regard to some class of information if, for any state of affairs represented in the system, that class of information must be specified. An example is provided by a map, which is specific with regard to directional information such as right and left turnings. Representing such spatial relations can be considered to utilize images. Other types of information may also require image systems, for example those representing referential relations.

Various empirical studies have attempted to show the existence of different types of representation. This is done by showing that people make use of mental representations that contain information other than propositional knowledge. Stenning (1978) showed that subjects freely chose to construct a map-like representation of a route when given a description of the route. They did this at least in part by supplying default specifications for spatial relations that were not supplied in the description. Shepard and Metzler (1971) studied mental rotation and observed that there was a linear function between the time taken to rotate and the angle through which the object had moved. Still, they point out, there had been no available models of rotation procedures that had operated on propositional representations. Later, Shepard (1978) showed that images can be mentally rotated at a rate of about sixty degrees per second. Kosslyn (1980), again, explains how images are used to represent spatial information and to solve problems. Paivio (1971) also belongs to the school of psychologists who argue for images as a distinct type of representation and for their function as an aid to success at a variety of memory tasks. The other school of psychologists regard images as epiphenomenal. According to them, there is only one form of mental representation, that is, strings of symbols that correspond to propositions (e.g. Pylyshyn 1973). The two schools make many similar claims about images and propositional representations, but the major divergence is that images are said to represent objects, whereas propositions are said to be true or not true of them (Johnson-Laird 1983, 148).

As we have noted, some empirical evidence shows that the contents of mental models, images, and propositional representations can be distinguished on the basis of their specificity. Models and images are highly specific. For example, it is impossible to form an image of a triangle in general; one has to think of a specific triangle. This means that in reasoning on the basis of a model or image, one's conclusion must go beyond the specific instance considered. Despite its specificity, a mental model can represent a general class of entities as well. This becomes possible because the interpretation of a specific model depends on interpretive processes, and a model can be treated as a representative sample from a larger set. Here we may note the methodological point that, in formulating what the model represents, the function of the model depends on a specification of structure and content as well as on an account of the processes that use the model. Since language is inherently vague, the content of models invariably embodies some arbitrary assumptions. No such need, however, exists in the construction of propositional representations. (Johnson-Laird 1983, 157-158.)

A slightly different approach to show the distinctive mental representations has been employed when people's ability to remember different descriptions has been tested. The problem has been linked to determinate and indeterminate descriptions. The specificity of descriptions provides grounds for hypothesizing that a propositional representation can handle both determinate and indeterminate spatial relations with equal ease, whereas a mental model should handle determinate relations more readily than indeterminate ones. Let us cite Pylyshyn's characterization to distinguish images from propositional representations: "It would be quite permissible ... to have a (propositional) mental representation of two objects with a relation between them such as 'beside'. Such a representation need not contain a more specific spatial relation such as 'to the left of' or 'to the right of'. It would seem an unreasonable use of the word 'image' to speak of an image of two objects side by side, without the relation between them being either 'to the left of' or 'to the right of'. (Pylyshyn 1973.)

On the basis of determinate and determinate descriptions, Mani and Johnson-Laird (1982) have made a series of experiments to investigate the hypothesis about levels of representations. As a result, they claim that subjects tend to remember the gist of determinate descriptions better than that of indeterminate descriptions, but they tend to remember the verbatim details of indeterminate descriptions better than that of determinate descriptions. Accordingly, they conclude that this 'cross-over' effect can only be explained by postulating at least two sorts of mental representation. Subjects are likely to construct a mental model of the determinate descriptions but abandon such a representation when they encounter an indeterminacy in a description and rely on a superficial propositional representation.

The above results lead Johnson-Laird (1983, 162) to reason that models are easier to remember than propositions, because they are more structured and elaborated and require a greater amount of processing to construct. Since models encode little or nothing of the linguistic form of the sentences on which they are based, subjects confuse inferrable descriptions with the originals. Propositional representations are fairly difficult to remember. But if subjects remember them, they make a better recognition than a chance recognition of the verbatim content, just because propositional representations encode the linguistic form of sentences. Hence, the studies give empirical evidence of the distinction between mental models and propositional representations.

Although generalizations to other areas are risky, I cannot help associating the above empirical findings with learning strategies. When the person does not understand the contents very well, he is likely to concentrate on the surface level and tries to remember the contents by rote, rather than understanding the contents at the deep level. This difference of orientation might be explained by the subject's inability or unwillingness to construct a proper mental model of the contents. In this case, he has not actually understood the propositional contents properly. This implies that a learner has a free choice of his learning strategy, and also, of what kind of learning outcomes he wishes to achieve.

There is another problem with indeterminacy in discourse, because indeterminate descriptions are not necessarily represented in a propositional form on every occasion. The text may give a reasonably clear impression of a room, but the description can be consistent with potentially any alternative room. Within the framework of his theory, Johnson-Laird (1983, 163-164) suggests four different strategies. First, one can simply stop constructing a model as soon as one detects an indeterminacy. Johnson-Laird assumes that that was just what their subjects did in their experiments. Second, one can try to construct alternative models representing the different possibilities. However, people seem to find it difficult to keep in mind even a few alternatives. Third, indeterminacy may be represented within a mental model by introducing a propositional-like element of notation. Unfortunately, it is hard to represent spatial indeterminacy within a dimensional model without resorting to so many propositional notations that the whole enterprise would be pointless. Fourth, one may plump for one specific model of the discourse, on the basis of an implicit inference. If the particular interpretation does not come in conflict with the subsequent discourse, there is no problem. If it does, one can try to reconstruct an appropriate alternative model. Of course, this alternative depends on access to the previous discourse.

The alternatives Johnson-Laird offers appear quite plausible, but I do not think that we have to choose just one. Various factors may contribute to the choice, and therefore, there is not a single solution. The third alternative also seems rather attractive to me, because the propositional-like model can cope with indeterminacy to some extent. I do not believe we have to fully accept Johnson-Laird's claim that spatial indeterminacy is hard to represent within a dimensional model. A propositional representation may handle indeterminacy and still create a structural relationship among the dimensional elements. This view is based on a representation that is produced by the linguistic context and that need not represent dimensional spatiality in every detail. Thus, one may construct a model on the basis of the linguistic notation that contains linguistic substance, a kind of propositional model.

Johnson-Laird himself regards only the first and the fourth of the above strategies as plausible alternatives if we think of human capacity. This is because, in everyday discourse, speakers usually follow conventional co-operative principles, which Grice (1975) calls conversational maxims. In other words, people do not deliberately tend to mislead their interlocutors. Consequently, only the fourth strategy is the most probable in implicit inferencing. The first alternative, Johnson-Laird believes, is likely to emerge in experimental situations rather than as a general strategy in everyday discourse.

In sum, Johnson-Laird's argumentation shows that models, images, and propositional representations can be functionally and structurally distinguished from each other, so that it is theoretically useful to speak of different kinds of representation. The distinction is a high-level one and, although the different types of representation can ultimately be reduced to a uniform code in the language of the brain, the functions of those representations cannot be predicted from that code of the microlevel. We made use of the analogue of a computer to describe the distinction between the micro-level operations and high-level ones. However, we must add that the analogue must refer to a kind of supercomputer that, at least in part, may process the different levels simultaneously, and not consecutively.

The above differentiation does not necessarily mean that they are the only types of representation. Johnson-Laird seems to be aware of this, because he claims that at least the three types may be distinguished. I accept his three types of mental representation in principle, but the propositional type of representation does not seem quite adequate to me, in terms of thinking. Johnson-Laird claims that descriptions are initially represented propositionally, i.e., by expressions in a mental language, and the semantics of the mental language maps these propositional representations into mental models. I take the expressions to refer to words as represented in the mental language. Johnson-Laird seems to assume that the mental language is essentially similar to a particular natural language. Although we need not accept this quite literally, his analysis is consequent from the perspective of comprehending discourse. But if we extend the propositional representation to propositional thinking, I do not think the representation can be so near the surface structure.

What I wish to argue for is a form of representation that is not fully free of the linguistic influence of a particular natural language, neither completely constrained by it. I should suggest that it is a propositional representation that corresponds to what is sometimes called internal speech. I owe the concept and the term to Vygotsky (1962 and 1978). Inner speech represents the inner, meaningful, semantic aspect of speech to be distinguished from the external, phonetic aspect of speech. Internal speech is verbal thinking but is not the interior aspect of external speech; it is a function in itself. Inner speech is to a large extent thinking in pure meanings. (Vygotsky 1962, 149.) This characterization is not unambiguous. However, such a representation is needed. It is not quite clear if it can be completely distinguished from the propositional representation dealt with by Johnson-Laird. The two representations may be reduced to one form, so that the difference is one of degree. However, I find the distinction relevant in terms of thinking which is not immediately related to understanding discourse. The distinction will particularly emerge in preparation for external speech. At the moment I do not have empirical evidence to quote for my thesis, but the matter will become clearer when I later discuss foreign language learning and thinking in a foreign language.

6. Meaning

The previous chapter showed that there are different types of representation that are employed in thinking. We noted that mental models represent states of affairs in the way that they encode little or no linguistic substance. Propositional representation was claimed to depend on the natural language that is used to express propositions. Since a natural language consists of words and sentences that express meanings, our interest focusses on meaning. The question of what meaning is has long puzzled scholars of philosophy, linguistics, and psychology, but no definite solution has been reached so far. Our ultimate goal is to understand how meaning is employed in thinking, so the psychological reality interests us particularly. However, the outcomes of some philosophical analyses also elucidate the conceptual aspects. This is also important because the grounds that underlie Johnson-Laird's theory of mental models in inferencing become explicable.

6.1.Model-theoretic semantics

Previously, the assumption was accepted that mental models are needed to account for inferencing without a mental logic. Such mental models are constructed by a semantics that operates on the propositional representation of the premises. In general terms, this process consists in mapping strings of symbols into models. In logic, the method is known as model-theoretic semantics, which lays out the structure of semantic interpretations. Based on Frege's work, and his original distinction between the *sense* of an expression and its *reference*, logicians have developed the concept pair of intension and extension in formal semantics. Central to model-theoretic semantics is the basic principle of compositionality, which says that the intension of a sentence can be built up compositionally from the intensions of its constituents in a way that depends only on their grammatical mode of combination (Johnson-Laird 1983, 168).

As a consequence of the principle, the meanings of words can be combined according to the grammatical relations between them, so as to yield the meanings of the constituents containing the words. For example, the meaning of 'young people' is built out of the combination of 'young' and 'people', and the meaning of the sentence 'young people travel a lot' is based on the meanings of the noun phrase and the verb phrase as a function of the grammatical analysis of the sentence. The word meanings of the sentence are analyzed by means of its syntactic structure. Idiomatic expressions are, however, interpreted as wholes and do not depend on compositionality. Such idioms are, for example, 'eat one's words', 'build castles in the air', 'make a clean breast of'. On the other hand, there is no denying that they may originally have been analysable into their constituents.

One restriction of the model-theoretic semantics developed by logicians is that it is fairly rigorous and directly applies only to formal languages. Since a semantic interpretation is given with respect to a model, and not to a real world, it is straightforward and provides no problem. This is because a model of a language is an abstract construct that consists of a function from syntactically well-formed expressions to elements in some specified model structure. Model-theoretic semantics does not provide a much more flexible solution for psychological reality in its more developed version. It was further developed by Tarski, who introduced the notion of satisfaction to apply to constituents for the definition of truth. Hintikka (1963) and others have formulated a model-theoretic semantics for the modal logics of necessity and possibility. A proposition which is necessary is true in all possible worlds and a proposition which is possible is true in at least one of the possible worlds. Applied to the Fregean distinction between intension and extension, we may note that the intension of a predicate is a function from the set of possible worlds to sets of individuals, whereas the extension of the predicate is the particular set of individuals to which it applies in the particular possible world under consideration.

Despite its restrictions, a model-theoretic semantics in logic offers an analogue of the process between the meaning and its mapping into a model, even though it is an idealization without reference to the human mind. For psychic processes, we are keen to know what information is needed for us to know the intension of the predicate. Although model-theoretic semantics acknowledges the existence of such functions, it does not indicate how they work. In dealing with a natural language, it is important to know how a predicate, say *man*, is mapped into a model. When a logician wants to express that all men are necessarily adults, he can add a meaning postulate to that effect. The postulate rules out any model-structure in which a man is not adult. The example has been followed by some psychologists who assume that the meaning postulates also account for the mental lexicon of a natural language. In the case of a mental model, this entails the assumption that there must be functions that (1) construct a model containing an entity satisfying the predicate *man*, (2), evaluate a given model to determine whether it contains an individual satisfying the predicate *man*, and so on. A psychologist also wants to know how those functions work. As a consequence of this procedure, mental postulates, however, become superfluous. Once the functions carrying out semantic interpretations are given some 'body' in this way, it is no longer necessary to use meaning postulates to constrain the interpretations of lexical items. (Johnson-Laird 1983, 181.)

6.2. What is meaning?

The vital question is what the meaning of a word is in a natural language. Philosophers have discussed the problem ever since classical times and offered various solutions. The problem centres around a contrast between the schools of realism and psychologism. Psychologism views meanings as mental constructions imposed on the world, and realism holds to the doctrine that meanings are determined by the nature of the world and are wholly independent of the way in which the mind works. The controversy underlies and is reflected in the different treatments of the features of meaning among philosophers and psychologists.

The most influential proponent of realism in modern times is Frege, who argued that one must distinguish the truth conditions of a proposition from an account of the mental processes by which one becomes conscious of them. Since he considered words to be correlated with entities in the universe, he stated that nouns refer to objects, which include physical objects, numbers and points in space. Predicates and relational terms refer to more complex concepts, which are abstract rather than mental entities. A concept is true of some objects and not true of others; it is defined by the essential characteristics of the objects of which it is true.

One of the central features concerns the question of whether the concepts corresponding to words consist of necessary and sufficient conditions. Until recently, it has been assumed that the different entities subsumed by a concept necessarily have some element in common, and that this set of elements suffices to define the concept. Psychological investigations of conceptual thinking have utilized this notion of a concept. The subjects have been made to discover the common element that characterizes a particular concept. The idea behind this is the assumption that a child acquires a knowledge of the common element as a result of different pairings of word and exemplar. The standard procedures for investigating conceptual thinking do not make a distinction between the processes by which subjects deliberately seek to acquire explicit concepts and those that occur in the implicit acquisition of concepts in everyday life.

Johnson-Laird and Wason (1977, 177ff.) argue against such methods, because they do not represent what happens in real life. This is due to the wrong sorts of concept and the wrong sorts of experimental procedure. It proves to be the wrong assumption that simple concepts are definable as sets of necessary and sufficient conditions, and that complex concepts are definable as such Boolean functions of simple concepts as negation, conjuntion, disjunction, and their combinations. Instead, ordinary concepts tend to have a relational structure. In teaching a concept, it is hardly thinkable of presenting a set of different stimuli and telling the child which items are instances of the concept. The concept is usually directly defined. Of course, there are concepts that cannot be defined; varieties of wine or styles of music may call for an experimental procedure. Further, it is important to note that, if a common element is discovered in an ordinary concept, then it often concerns function rather than form. (Johnson-Laird 1983, 186-187.)

The controversy between realism and psychologism may be found in one and the same man. The young Wittgenstein, in his *Tractatus*, advanced a realist position of semantics and claimed that the meaning of a proposition is its truth conditions. If a proposition is true, then it corresponds to a state of affairs in the world. Later, he rejected the view that concepts can be defined in terms of essential characteristics or necessary and sufficient conditions, and talked of criteria (Wittgenstein 1953). The notion has been shown to be controversial, but Johnson-Laird (1983, 189) cites sources that offer illuminating interpretations. Criteria are fixed neither by experience, which supports inductive generalization, nor by logical necessity, which support entailments, but by convention. This interpretation excludes criterial relation from any orthodox logical category, because it is weaker than entailment but stronger than an inductive generalization.

How such criteria might be construed naturally might be borrowed from Minsky's idea (1975). He developed a so-called frame theory within which default values can be employed to account for some expectations. Johnson-Laird (1983, 189) takes advantage of the notion and applies it to word meanings. Default values are characteristics of an object which can be presumed unless there is evidence to the contrary. Let us take the term 'dog', which we can think of having such characteristics as four legs, a tail, fur, a tail, the ability to bark, etc. However, these are not necessary conditions, because a dog can have no tail or only three legs. Neither are they inductions based on observation. The characteristics are part of the concept of a dog, and could be part of what Wittgenstein called the 'grammar' of things. Also, Johnson-Laird points out an interesting connection between the criteria and truth: since the criteria are determined by what is possible to think, truth and falsity are not independent of human cognitive capacity.

If we accept the notion of criteria, we have to admit that concepts lack clear-cut boundaries, which is a conclusion contrary to Frege's realist doctrine. The question then arises of how to characterize criteria. One suggestion is a schematic model corresponding to the concept. The concept of schema dates back to Kant's Critique of Pure Reason, where he suggests that not images but schemata lie at the foundation of our pure sensuous conceptions. No image is adequate to our conception of triangles in general. The schema of the triangle can only exist in thought, indicating a rule of the synthesis of the imagination in regard to pure figures in space. Consequently, a schema is not an image, but a model that underlies the ability to form an image.

The idea that a concept is represented by a schema that specifies the typical or default characteristics of the items it subsumes is not new in psychology. As a matter of fact, a number of experiments have been conducted around it. The results have indicated some kind of focal points in the space of concepts. For example, Rosch (1976) has conducted a series of experiments and argues that many natural categories are internally structured into a prototype (clearest cases, best examples) of the category with non-prototype members tending toward an order from better to poorer examples. Categories reflect real-world correlational structures. All cognitive categories are obviously interactions between the correlational structures that exist in the world and the state of knowledge of the perceivers. In other words, real objects have features that are correlated, and the pattern of correlations is reflected in the schema. This is exemplified by the observations that feathers are found on wings, and scales on fins.

The above discussion has shown various ways of analyzing the conditions of meaning, and there is no denying that examples exist in favour of different views. The reason for this is that, in actual fact, words differ in their conceptual characteristics. This is seen when we analyze the meanings of everyday words. The nature of meaning differs from one word to another, for intensions are not uniform. Words coming from different parts of speech obviously differ from each other. But even ordinary nouns have differences in meaning.

Some words are analytic in the sense of setting essential conditions that support necessary truths. For example, the noun *bachelor* supports the truth of 'A bachelor is an unmarried man.' Similarly, technical terms that can be defined by stipulation have a set of necessary and sufficient conditions. The true intensions of such natural kind terms as *lemon*, *gold*, and *cow* are not known, so that they are mentally represented by schemata, which presuppose a specification by default values. A third group of nouns, like *home*, *chair*, and *melody*, have what Johnson-Laird calls a constructive semantics. The intensions of such words are mental constructions, imposed on the world. Although constructive terms designate entities in the world, they lack an underlying structure that determines their membership of the extension. Therefore, their meaning is a matter of convention. Artifacts, like a chair and a car, can also be considered constructive terms, because central to their specification is their intended function rather than their intrinsic structure. (Johnson-Laird 1983, 196.)

While concepts that have necessary and sufficient conditions do not cause any problem as to their extensions, words whose intensions are specified by schemata and default values raise the question of the nature of their corresponding extensions. Some scholars have suggested the use of fuzzy sets for their elucidation, but others have convincingly argued against their rationality and rejected them as inappropriate in the case of natural languages. Since all predicates are not extensionally precise, the boundaries between classes of objects cannot be mapped with precision.

Miller and Johnson-Laird (1976) have suggested a simple way of specifying extensions, which is based on two cardinal principles: the representation of classes of entities by schemata, and the taxonomic interrelation of schemata. Our concepts of objects and properties consist of specifications of the criteria of typical instances. The boundaries of a word's extension are not, however, set by its schema, but by the nature of the particular taxonomy in which the schema occurs. For example, whether something is to count as a *dog* depends on its similarity to typical dogs. There are a great number of varieties of taxonomic relations. The most clear-cut relations are hierarchies created by class-inclusion, e.g., poodle — dog — mammal — animal — physical object, and contrastive sets, e.g. the basic colour terms. However, many semantic fields have a complex structure. The advantage of a taxonomic organization of the lexicon is that speakers are not forced to be precise in cases where they are ignorant. The only real problems arise when an object is 'equidistant' from a number of prototypes in the taxonomy. A taxonomy allows for relatively simple meanings of words that can be encoded as schemata and that can be readily acquired by children. (Johnson-Laird 1983, 203.)

6.3. How is the meaning of a word mentally represented?

The above discussion has attempted to answer the question of what the meaning of a word is on the basis of a semantic analysis of meanings. Another question connected with this concerns the psychological problem of how the meaning of a word is mentally represented. There are three main answers to this question in psychological literature. They are the theories of lexical decomposition, semantic networks, and meaning postulates. Since Johnson-Laird develops his own theory by analyzing the above theories, arguing against their shortcomings and comparing them with his own, we must follow the argument to some extent in order to understand the true nature of his theoretical development.

Katz and Fodor (1963) originally presented the idea that words are represented in a mental dictionary that decomposes their meanings into semantic components. They assumed that a sentence is semantically interpreted so that its words are replaced with their semantic representations, which are then combined according to the underlying syntactic structure of the sentence. Their theory stated that the semantic representation primarily comprised a set of semantic markers, which decompose the meaning of the word into more primitive semantic constituents. A word that has several meanings is constrained by its possible combinations with the meanings of other words. In principle, the theory presumes that the meanings of words can be decomposed into sets of necessary and sufficient conditions, even though it is modified a little in its psychological version to account for prototypes.

The need to decompose the meanings of complex words into their semantic constituents has led researchers to test the theory by measuring the processing time of words of varying semantic complexity. For example, 'A man lifts a boy' should be harder to understand than 'An adult lifts a child.' Kintsch (1974) could find no such differences in a number of experiments. There are other reports of such failures. However, the outcomes from the measurements of the processing time for sentences containing inherently negative terms appear to support the decompositional hypothesis (Clark and Clark 1977). Those investigators do not consider the results corroborate the hypothesis, because the tasks required more than mere comprehension. Miller and Johnson-Laird (1976, 326ff) also point out that decomposition as a necessary process in comprehension is a different matter from the question of the existence of semantic primitives.

A vast body of psychological experiments have utilized the idea of semantic networks for the development of theories of meaning. Most of them have been applied to computer programmes within the research of artificial intelligence. However, such models have also served as simulations of human performance since Collins and Quillian (1969) introduced it into their investigations. In such experiments, the meaning of a word is regarded as a set of verbal associations, which involve a variety of different sorts of associative link, including class-inclusion, part-whole, property of, and variable relations as specified by a third defining word. The results of several experiments suggested that semantic memory does consist of a hierarchical network, and the notion of a hierarchical retrieval of semantic information was also supported (Collins and Quillian 1972).

Some of the later research has ended in incongruent interpretations, and the original idea of regularity has proved to be a more complex matter than was expected. The theory of semantic networks has partly been confounded in the interpretations of results, because the strength of associative networks due to the frequency of occurrences has not been separated from the associate strength of semantic relations. Subsequent experimental studies have shown that a major difficulty for the semantic network theory is that it fails to predict differences within categories. Therefore, it is wise to give up semantic networks as a specific psychological hypothesis and treat them as reflecting a commitment to a certain form of computer implementation (Johnson-Laird 1983, 214).

A third psychological theory of meaning hypothesizes meaning postulates that were mentioned in connection with the model-theoretic semantics, because they were originally used to specify necessary relations between predicates, e.g., for any x, y, and z, if x sells y to z, then z buys y from x. From formal semantics, they have been adopted for the development of psychological theories of meaning by Kintsch (1974) and Fodor, Fodor, and Garrett (1975). Meaning-postulate theories assume that comprehension consists in translating utterances into a mental language which represents a sentence very closely in its surface form. The words of natural language correspond virtually one-to-one with the unanalyzed tokens of the mental language. The crucial claims of the theory are that there are no semantic primitives, and accordingly that there are no mental dictionary entries representing the meanings of words. (Johnson-Laird 1983, 216.)

Johnson-Laird discusses both claims at some length. In the previous section, we have already noted that different words demand different forms of semantic analysis, so, on that basis, the theory of mental postulates appears inadequate, because it assumes too powerful an analysis for natural kind terms and too weak an analysis for analytic terms. After having conducted a series of experiments, Johnson-Laird (1983, 22) concludes that semantic information is indeed gathered together in the form of dictionary entries. Hence, the third psychological theory of meaning has lost its appeal, too.

All the three theories propose that the meanings of words are represented by expressions in a mental language. Each of them has their own inadequacies implied above. However, they all share one major disadvantage: they do not explain how these expressions relate to the world. In other words, they tacitly rely on the psychological principle that intensions are processed autonomously. However sophisticated a theory is to describe the relations between words, it is not a complete semantics if it does not say what they pick out in the world. The task for psychological semantics is to show how language and the world are related in the human mind, that is, how the mental representation of sentences is related to the mental representation of the world. (Johnson-Laird 1983, 232.)

In his objection to the psychological autonomy of intensions, Johnson-Laird takes up four aspects of semantic interpretation that have trouble with this principle. The ambiguity of words is resolved by means of context and it presupposes an interaction between meaning and reference. Although the sense of a word is selected, it cannot be done on the basis of fixed semantic constraints. An implicit inference is actually based on context and matters of fact. On the basis of experimental studies, he discusses the issues of interpretation.

One of the basic features of natural language is that it is ambiguous, even so that the more frequently used a word is, the more likely it is to be ambiguous, apart from grammatical function words (Miller 1951). It can be shown that the sense of a word is selected by an implicit inference based on context. This, however, violates the notion of the psychological autonomy of intensions. Once context is taken into account, it is natural to extend the idea to cope with regularities that are factual and inductive rather than conventional or linguistic. (Johnson-Laird 1983, 237.)

It has been shown that words have a whole family of potential meanings. So the occurrence of a word in a specific linguistic context is said to *instantiate* a specific sense of a member of the family. This claim is consistent with the autonomy of intensions, but Johnson-Laird shows convincingly that the instantiation is not a specific meaning, but a specific referent. The subjects construct mental models on the basis of the sentences they are given and of their general knowledge. They make implicit inferences about the entities that are being referred to.

R.C. Anderson and his colleagues (1976) have shown experimentally that context narrows down the interpretations of words. For example, the sentence 'The fish attacked the swimmer' is later recalled worse than if the subjects are given a more specific and more likely term *shark* as a recall cue instead of *fish* from the original sentence. As Bransford and his colleagues have shown (Bransford and McCarrell 1975), the subjects in memory experiments go beyond what is linguistically given. If they are presented with the sentence 'Three turtles rested on a floating log and a fish swam beneath them', they are likely to assert that the fish swam beneath the log. This cannot be explained on the grounds of the instantiation of a more specific meaning, but by assuming that a mental model of the state of affairs was constructed.

The above examples have already illustrated the necessity of the reference of some expressions to play its part in determining the senses of other expressions. Further, the vagaries in the logical properties of spatial relations cannot be coped with without mental models, i.e., without reference to the state of affairs. The same applies to deictic expressions. They cannot be understood if the listener or reader does not recover the appropriate referent. A striking example by Nunberg (1976) shows how reference transcends literal meaning. 'The ham sandwich is sitting at table number 5 and getting impatient' seems a fairly unrealistic remark unless we know that a waiter might employ such an indirect reference to the client who ordered the ham sandwich. The example also seems to speak against Rommetveit's (1979) hypothesis that the most obvious effect of context is a process of elimination, i.e., that only a fraction of the meaning potentialities are operant once an initial process of reference has been assessed.

6.4. Meaning in terms of a foreign language

The preceding sections have attempted to illustrate the problem of meaning in terms of the concept and its psychological representation. The analysis is important for understanding the vehicles that the human mind has at its disposal for thinking. The presumption of the discussion has been that the available linguistic material has been acquired as a person's mother tongue, i.e., as a natural process of language learning. The problem of meaning will, however, change its character when meaning is expressed through a foreign language. We may ask whether the same theories of characterizing meaning are still valid without any modification.

Without going into the question of how the foreign language is taught or how it is acquired, we may ask whether the meanings of the foreign words can be defined by sets of the necessary and sufficient conditions. It is possible to think of foreign-language words as independent entities whose meanings might be characterized by stipulative definitions. That, however, presupposes that the meanings of the foreign words are undeniably definable. But we have seen that that is not the case. Assuming, however, that the intensional meanings are seemingly unproblematic, we may think, for example, that a learner is taught a particular word, and its meaning is correlated with the corresponding native language symbol. Then, if we follow the doctrine of autonomous intensions, the native-language word represents the intension of the foreign-language word. But is a direct and unproblematic correlation possible?

The answer to me seems negative. If natural categories are mentally represented by prototypes or schemata, their nature does not change according to whether they serve as the basis of meaning in a native or a foreign language. The only conceivable thing to take place in such a correlation is the transference of the intensional characteristics of the native word into the intension of the foreign word. Then, a question arises of the similarity of their schemata. Obviously, many schemas do correspond to each other, particularly if the speakers' cultures do not differ markedly. However, potential misconceptions may occur. Let us take an example. The Finnish word 'hirvi' is translated into 'elk' in Europe, whereas 'moose' is employed in America. The animal itself actually belongs to the race of the moose. The schemata of the two words appear to differ in the European usage.

As Rosch (1976) claims on the basis of her experimental observations, both the basic category cuts in the environment and the cognitive prototypes of those basic categories are determined by the physical and social facts in a given environment. Only those structures that exist there can be perceived. Since both the man-made objects and the flora and fauna of a region as well as people's interest in different attributes differ in different parts of the world, it is no surprise that their correlation for specific domains should contribute to differences in the content of categories. An evident consequence of this is that a foreign language user must be aware of such differences, if he is to think in terms of similar meanings with the native speaker. He must also take the extension of a word into account in order to master its intensional meaning.

If even natural kind terms differ in intension, the same thing is more likely to concern words with a constructive semantics, because their meaning is a matter of convention. A potential source of error for Finnish speakers may be the different conceptualizations of the following artifacts in Finnish and English:

car	(henkilö)auto
van	(paketti)auto
lorry	(kuorma-)auto
bus	(linja)auto

Although the words in the two languages can be specified respectively, the Finnish *auto* can be used for all the words as a generic term, depending on the context. This conceptualization may be generalized to one of the English equivalents, to *car*, most probably. The meaning of *auto* is not, however, so generic as the English *vehicle*. Hence, the specification may be one of the many potential differences among the intensions of different languages. The real-word objects are self-evident in both cultures, but the word meanings may be specified by their schemata to a varying extent. As a consequence, their intensions factually differ from each other.

We have noted that the intensions of words include a certain amount of vagueness in a native language. For a foreign language speaker, there will be a considerable increase in vagueness when the intensional schemata in the foreign language differ from those of his own language. It may be assumed that intensions differing in nature are affected by a various amount of vagueness. The discrepancy of the intensional vagueness between a foreign language and the native language requires an extensional specification of the foreign-language intension. That again speaks against the autonomity of intensions. If the intensional vagueness of meaning can be compensated by default values, the number of slots is even greater for a foreign language speaker. The growth is a conceptual fact, rather than an empirical question of how he can cope with that in practice. For practical purposes, a systematic linguistic investigation that compares the meanings between the native language and a foreign language and takes their extensional nature into account may give useful hints of what types of intensions are relevant to be discussed in terms of teaching a particular foreign language. The differences are likely to vary among the pairs of comparison.

The question of how meaning is mentally represented in terms of a foreign language is difficult to answer at the present state of the study. The three theories of mental representation will be out of place. Since they cannot account for meaning in the native language, it would be absurd to believe in their power to explain the representation of meaning for a foreign language speaker. The essential defect is their failure to grasp the extensional part of the word meanings. It was seen to be at least as vital an aspect for a foreign language speaker as for the native speaker. Since the theory of mental models is meant to work to that effect, the matter will become clearer in the next chapter. Further, it is worth remarking that the problem of the psychological representation of foreign-language words is intimately connected with both their meaning and their form. The form probably plays a more important role than in mother-tongue words, so that they may be interwoven in representations. Hence, matters of how and when foreign languages are learnt and taught are likely to have a more significant influence on how foreign-language vocabulary is mentally represented. We shall take up the subject later.

7. A theory of comprehension

In the previous discussion we have claimed that meaning cannot be presented as psychologically autonomous intensions. Their extensions are needed to explain the meanings of words. Therefore, both these aspects must be linked together for people to understand the meanings of words and sentences. It was noted earlier that at least two separate levels of representation could be distinguished: a propositional one and mental models. Johnson-Laird makes use of these representations to explain how the intensional and extensional aspects are linked together for the construction of meaning. The outcome is a theory of comprehension, in which there are two stages: a superficial one, and a more profound one, which is optional and connected with the states of affairs.

The superficial understanding produces a propositional representation, which closely follows the surface structure of the sentence, and which is constructed in a mental language that has a vocabulary similar to that of natural language. Other scholars, Kintsch (1974) and Fodor, Fodor and Garrett (1975), for example, have also assumed such a mental language, even though they have independently developed their views. Propositional representations are likely to resemble surface form rather than direct phonetic or graphemic transcriptions of an utterance, because native speakers can hardly avoid identifying words and recovering syntactic relations.

The second stage of comprehension is based on propositional representations, by means of which a person constructs a mental model with a structure analogous to the state of affairs described in the discourse. The constructive process is also guided by contextual cues and implicit inferences based on general knowledge. A relevant characterization is that an utterance is more like a clue to the design of a model than a blueprint. The theory of mental models elucidates the second stage of comprehension. "The essential context of an utterance can be represented in a mental model, and the significance of the utterance is established by relating its propositional representation to this model and to general knowledge. When the referents have been identified, the new information conveyed by the utterance can then be added to the model to bring it up to date. This process, however, may well occur clause by clause, or constituent by constituent, rather than at the level of complete sentences." (Johnson-Laird 1983, 245.)

In connection with the different types of representation, some evidence was mentioned that corroborated the distinction. A mental model was reported to require more processing time than processing a propositional representation alone. As a consequence, it was possible to predict a better recall of a mental model than a proposition. The hypothesis has been confirmed by empirical findings. People do not normally remember sentences in the exact form that they are presented in or in their underlying syntactic structure. It has also been noted that the meanings of sentences go beyond the linguistic information. This can be explained by a mental model, which embodies inferences, instantiations, and references. Therefore, the meaning of a sentence cannot be recovered from the model.

As a further point corroborating the distinction between the propositional representation and mental models, Johnson-Laird (1983, 245) mentions euphemisms. Their very efficacy depends on the possibility of two intrepretive levels. Euphemisms are designed to be represented propositionally and to deter full interpretation, whereas obscene words in their literal meanings lead straight to a model of the world. Thus, the acceptable and the shocking use of the language bears out the existence of the two representations.

Johnson-Laird develops the two stages of interpretation into a comprehensive theory. The second stage deals with the mapping of propositional representations into mental models in order to represent the significance of discourse. The first stage comprises the initial translation into a propositional representation. We shall start with the second stage.

7.1. A procedural semantics for mental models

Model-theoretic semantics maps the expressions of language into model structures, which, in the case of natural language, can be claimed to consist of possible worlds. In order to create a rapprochement between semantic theory and psychology, Johnson-Laird (1983) argues for a resolution of the problem: a mental model is a single representative sample from the set of models satisfying the assertion. A representative sample is obtained by comprehension that leads to just a single model, which is constructed by the procedural semantics from what is known about the truth conditions of an assertion. The particular model is constructed on the basis of default inferences from the general knowledge triggered by the discourse. The outcome is an exemplar of a likely situation. The recursive procedures can, however, replace one sample by another, though the capacity of working memory sets its limits in practice.

Let us see the assumptions of the theory in some detail. Johnson-Laird's theory of comprehension assumes that there are procedures that construct models on the basis of the meanings of expressions. The view derives from an approach to the psychology of meaning called procedural semantics, originally based on computer programming. Johnson-Laird's theory uses a procedural semantics to relate language, not to the world, but to mental models.

A word can function in many different sorts of utterances so that the representation of its meaning must fit into a range of different mental processes. Likewise, an assertion may be put to use in a variety of ways. If you are told that 'John is standing next to the host', you may imagine on the basis of the information that they are standing side by side, or you may try to determine which person the host is, or which person John is, or to check that John is standing next to the host. You can also use words to formulate a description of a given state of affairs, in making a request, and so on. These various processes depend on a knowledge of the meanings of words and sentences, but it is important to note that none of them should be identified with that knowledge, because they are contingent upon it. (JohnsonLaird 1983, 249.)

Several general procedures are required to translate an assertion into a mental model:

1. a procedure that begins the construction of a new mental model whenever an assertion makes no reference, either explicitly or implicitly, to any entity in the current model of the discourse;
2. a procedure which, if at least one entity referred to in the assertion is represented in the current model, adds the other entities, proporties, or relations to the model in an appropriate way;
3. a procedure that integrates two or more hitherto separate models if an assertion interrelates entities in them;
4. a procedure which, if all the entities referred to in the assertion are represented in the current model, verifies whether the asserted properties or relations hold in the model.

The verification process may be unable to establish a truth value of an assertion: there may be no information either way about the relevant property or relation. For example, a model of John standing next to the host does not yield a truth value for 'John is taller than the host'. In such cases, there is

5. a procedure thàt adds the property or relation (ascribed in the assertion) to the model in the appropriate way.

As a consequence of the claim that only a single model is constructed for a single assertion, the procedures that construct models will be forced to make arbitrary decisions, since ordinary assertions are always consistent with more than one state of affairs. Such a decision may be wrong in that it leads to a conflict with subsequent information in the discourse (as revealed by the verification procedure). Hence, two recursive procedures are needed to cope with the simulation of the 'non-deterministic' device that always constructs the right model. The procedures embody the fundamental semantic principle of validity:

6. If an assertion is found to be true of the current model (by the verification procedure), then the present procedure checks whether the model can be modified in a way that is consistent with the previous assertions but so as to render the current assertion false. Where no such modification is possible (without doing violence to the meaning of the previous assertions), the current assertion adds no new semantic content: it is a valid deduction from the previous assertions.
7. If an assertion is found not to be true of the current model (by the verification procedure), then the present procedure checks whether the model can be modified in a way that is consistent with the previous assertions but so as to render the current assertion true. When no such modification is possible (without doing violence to the meaning of the previous assertions), the current assertion is inconsistent with the previous assertions.

The unfortunate fact about the recursive procedures for revising mental models is that they do not work exhaustively and without error. As we have noticed earlier, people make erroneous inferences. There are indeed few individuals that perform without error.

In the course of comprehension, the propositional representation of an utterance elicits one of these seven general procedures as a function of its referring expressions, the context as represented in the current mental model, and the background knowledge that is triggered by the sentence. In this way, a model is initiated, extended or evaluated according to what is known about the truth conditions of the assertion. (Johnson-Laird 1983, 249-250.)

Johnson-Laird has made a small-scale 'working model' of his theory of how a procedural semantics is used to produce mental models. It is made in the the form of a computer program to test the theory's feasibility. It is not intended to simulate the complexities of human performance. The details of this program are beyond the scope of this paper, but there are some conclusions that are relevant to understanding how procedural semantics can cope with the infusion of the intensional and extensional aspects of meaning.

The theory of procedural semantics has implications for the status of semantic primitives. We noted earlier that there are semantic primitives which lack an underlying structure that determines their membership of extension. Their semantics was said to be constructive. Similarly, there are basic spatial terms such as *right* and *left* whose meanings cannot be lexically analyzed into decompositional constituents, because those words cannot be defined in more primitive terms. They are not, however, primitives, because a spatial computer program making use of procedural primitives can cope with the semantics of these words. The meanings of the words in the object language (a highly restricted subset of English) are formulated in procedural terms that have no simple relation to the object language. In it, the primitives are ineffable just as the true semantic primitives. Johnson-Laird's program shows the need to employ such primitives in order to specify the truth conditions of expressions. Likewise, human beings know how to relate expressions to models of the world. (Johnson-Laird 1983, 250-262.)

Procedural semantics clearly reveals the weaknesses of psychological theories based upon meaning postulates, semantic networks, or decompositional dictionary entries. They purport to capture the semantic properties and relations of expressions, but they give no account of their truth conditions. Since procedural semantics gives a full specification of truth conditions, no independent formulation of semantic properties and relations is required. They emerge naturally from the truth conditions. Since the truth conditions of many words are impossible to formulate in the object language, the above psychological theories cannot capture their truth conditions. Therefore, a theory that employs semantic primitives surpasses the above theories. (Johnson-Laird 1983, 262-263.)

Miller and Johnson-Laird (1976) suggested that words are organized taxonomically. Thus, we may assume that acquiring their intensions are taxonomic too. The procedural primitives are therefore likely to be organized into a taxonomic device that provides the structure for the relevant lexical domain. The theory of mental models then suggests that children acquire the truth conditions of expressions in learning language. In getting to know a word, they will also master its logical properties, given that their general skills allow them to handle mental models.

Although we need not accept the taxonomic organization of words as the only solution, the fact remains that word meanings also embrace extensional schemata, and thus logical properties which become an inherent part of thinking. Since the extensional schemata of words are likely to differ to some extent from language to language, this has natural consequences for mastering the meanings of foreign language words. The use of foreign words constrains the construction of the correct and exact meanings of propositions, depending on how much the particular foreign language differs from the schematic intensions of the native language. To what extent the procedural primitives and semantic primitives vary in different languages is a matter of investigation for contrastive analysis. Constructive terms will, however, remain a problem for foreign language learning and teaching.

7.1. From utterances into propositional representations

In dealing with the parsing of natural language, it may be useful to distinguish between grammatical structure, its mental representation, and a process by which that structure is recovered. Grammatical structure is a matter for linguistic analysis, whereas the latter two require psycholinguistic investigation. Although the psycholinguistic area is pertinent to the theory of understanding language, it is less relevant to our aim to elucidate thinking in a foreign language. My point is not to underestimate its importance, but its scope is so vast that it needs a research enterprise of its own. Therefore, I intend to discuss the parsing of natural language as parsimoniously as possible and take up only those features that are necessary for the later development of the subject matter.

In principle, there are two general strategies to the problem of how the mind recovers the grammatical relations inherent in a sentence. The one alternative is to argue for a parser that operates with a minimal computational power and lacks the power to analyze the complete language. The other alternative makes the assumption that the grammar is of a minimal power, but the parser employs all possible resources. Johnson-Laird (1983) argues for the latter, because a restricted grammar may adequately specify the syntactic structures of English sentences. Such a grammar without a deep structure is compatible with the psychological evidence, because a direct mapping may be established from utterances to semantic representations, and vice versa.

A number of psycholinguists have argued that syntactic processing is autonomous, by which they mean that semantic and pragmatic factors have no effect on syntactic processing (Fodor, Bever, and Garrett 1974, for example). Empirical results are, however, controversial. There is evidence for the interaction of the processes. Johnson-Laird has noted several sources of interaction between syntactic and semantic processing. The general mechanism underlying such interactions must build up the correct propositional representation of a sentence on the basis of a concurrent syntactic and semantic analysis. There are two alternatives for organizing the concurrent decisions. We may assume a syntactically driven process in which semantic cues eliminate inappropriate interpretations, or a semantically driven process in which inappropriate interpretations are eliminated by syntactic analysis. Johnson-Laird chooses the former alternative, because a combination of lexical items may yield many possible propositional representations when syntax is not taken into account. The parser uses the grammar to build up a propositional representation based on the lexical semantics. Where there is a choice, it can be guided by further semantic information in the lexicon, by the mental model of the discourse, or by general knowledge. (Johnson-Laird 1983, 336-337.)

I think the syntactic driven analysis is correct. A corroborating fact is obtained if we think of how the Finnish language works. Since Finnish is an agglutinative language, its case grammar guides the syntactic parsing. The lexical items in their non-inflected form could, in principle, be put in any order and there would be only a few reasonable guesses about the proposition that might be intended by the words. This is due to the fact that there are no articles, practically no prepositions, and most verbal expressions (tense, mood, question ending) can be formed inflexionally. In addition, the word order is relatively free, even though some patterns are favoured. In principle, the word order does not usually have a meaning bearing effect, apart from questions. As soon as a word has been uttered, the listener has received not only semantic but also a great deal of syntactic information in order to start constructing a propositional representation. The semantic cues would not eliminate the choice of alternatives to the same extent as the syntactic information.

To cite an example, let us look at a few instances of the Finnish words *talo, myydä, hevonen* (house or farm, sell, horse). There are numerous possibilities when each constituent is varied in turns:
Talon/talojen hevonen/hevoset myydään/myytäneen/myytiin.
The horse/s of the farm/s will be sold /will perhaps be sold/ was/were sold.
Talon hevosta/hevosia myydään.
The horse/s of the farm is/are being sold / for sale.
Taloihin myytiin hevosia. Horses were sold to the farm/s.
Myytiinkö talon hevoset? Were the horses of the farm sold? etc.

The semantic meaning of the first word in a sentence does not give much information about the proposition without the grammatical guidance. Hence, the syntactically driven process is more likely to start the construction of a propositional representation and also lead the whole performance with the help of the semantic cues. Some experimental observations also corroborate this view. When a Finnish speaker is given a cloze test (the blanks of a text to be filled in with omitted words), he is faced with a more difficult task than an English speaker, at least in the sense of guessing the original word. This can be explained by the greater amount of information that is omitted in the Finnish version in comparison with an English test. The analytic English language leaves more information after the removal of the original words.

7.3. The coherence of discourse

There is a lot of empirical evidence that discourse has structure. But views differ about what it is that makes the structure. For example, several psychologists have independently suggested that there are *story grammars*, in analogy with grammars of a language. Such a story grammar should specify the large-scale structure of certain stereotyped varieties of story, such as folk-tales. All the story grammars in the literature, however, fail to do what they promise. They lack explicit definitions of their terminal categories; their semantics is based on an unacknowledged reliance on general knowledge; and they use context-free rules without being motivated (Garnham, Oakhill and Johnson-Laird 1982).

Johnson-Laird's theory of mental models can be utilized to account for the structure of discourse. A necessary and sufficient condition for discourse to be *coherent* is that a single mental model can be constructed from it. That is possible if the conditions of co-reference and consistency are fulfilled. If each sentence in a discourse refers, explicitly or implicitly, to an entity referred to or introduced in another sentence, the discourse is co-referential. Likewise, consistency presupposes that the properties and relations ascribed to referents must be compatible with one another and free from contradiction. In addition to coherence, *plausibility* is vital to discourse, but it must be distinguished from coherence. Plausibility depends on the possibility of interpreting the discourse in an appropriate temporal, spatial, causal, and intentional framework. Miller and Johnson-Laird (1976) have argued that such a framework cross-classifies all semantic fields. The concepts of coherence and plausibility are theoretically distinct, and it has also been demonstrated experimentally. (Johnson-Laird 1983, 370-371.)

Coherence is a property of discourse whereas plausibility concerns more than discourse, because an actual sequence of events depends on a temporal, causal, or intentional framework. The latter aspect has inspired scholars to form various hypotheses about the organization of the knowledge underlying plausibility. Minsky (1975) suggested a frame theory. In a new situation, one selects from memory a data-structure called a *frame*, which represents a stereotyped situation like being in a certain kind of living room or going to a child's birthday party. We can think of a frame as a network of nodes and relations. The 'top levels' of a frame are fixed, and represent things that are always true about the supposed situation. The lower levels have many *terminals* - slots that must be filled by specific instances or data.

Schank and Abelson (1977) developed Minsky's frame idea and specified it further by the construct of scripts. A script is basically an ordered sequence of actions appropriate to a particular spatial-temporal context, organized around a goal, such as dining at a restaurant, or a birthday party script, a football game script, a classroom script, and so on. The script is made up of slots, and for each slot there are default values that are assumed if the person, object, or action is not specified when the script is instantiated in a particular context. Since scripts are not subject to much change; they do not provide the apparatus for handling novel situations, which plans do. Plans describe the set of choices that a person has when he sets out to accomplish a goal. In listening to a discourse, a person may try to find a plan in order to make guesses about the intentions of an action in an unfolding story and use these guesses to make sense of the story. Also, a script enables the speaker to leave out many things that he may assume that the listener can fill in by default. In a text, new script information is interpreted in terms of its place in one of the causal chains within the script. Similarly, Grice (1975) assumed that speakers and listeners have to co-operate to succeed in communication: they have to satisfy so-called conversational maxims. Following them allows the participants to understand many unspoken details.

The notion of script is not unproblematic. Not all events are stereotyped and causal in structure. Abelson (1981) has loosened the conditions and specified it by distinguishing weak and strong scripts. A weak script prescribes what objects, roles, and component events can be expected in a situation but does not prescribe the precise sequence of events, just because they are inherently variable. A strong script, however, also prescribes the sequence of events, usually because there is a causal dependency among them. For example, in a restaurant one must order before the food is served and the food must be served before one can eat. Strictly speaking, order in a strong script may often be simply conventional, and not causal.

Frames, scripts, plans, episodes, and scenes are constructs that are not in their final state yet, and much investigation is needed for their refinement before they can explain the plausibility of discourse. Since the knowledge that people have of scripts is socially and conventionally determined, they are likely to differ from society to society, at least to some extent. If they are, however, important for the plausibility of discourse, the scripts of a particular society are vital for those who learn its language as a foreign language. For the time being we must, however, admit that there is a lack and need of a good theory of the plausibility of discourse.

7.4. Comprehension in terms of one representation

There have have been various attempts to analyze the structure of discourse. In contrast to Johnson-Laird's claim for two kinds of representation for discourse, most other enterprises have worked with one type of representation. It is not only typical of linguistics; psychological theories also rely on one kind of representation. This is particularly so within the tradition that holds the view that knowledge is represented in memory in terms of propositions. For example, Kintsch and van Dijk (1978) hypothesize that discourse is interpreted propositionally. The semantic structure of a text can be represented as a structured list of propositions containing a relational concept (predicate) and one or more arguments. The arguments fulfil different semantic functions, such as agent, object, and goal. In the surface structure predicates may be realized as verbs, adjectives, adverbs, and sentence connectives. Each predicate constrains the nature of the argument that it may take by linguistic rules and general knowledge of the world. The text consists of a microstructure and a macrostructure. The microstructure is the structure of the individual propositions and their relations, whereas the macrostructure characterizes the discourse as a whole. The two levels are related by a set of specific semantic mapping rules called macrorules.

The semantic microstructure of a discourse is characterized in terms of an abstract *text base*, which is a coherent and structured unit, due to its referential coherence. Propositions need not necessarily be directly connected because language users are able to infer the missing links of a sequence on the basis of their general or contextual knowledge of the facts. Therefore, the authors distinguish between an implicit text base that expresses an actual discourse, and an explicit text base that is a theoretical construct also featuring those propositions necessary to establish formal coherence. The semantic macrostructure of discourse connects the propositions of a text base in relation to a topic of discourse. In addition, a global constraint is required to establish a meaningful whole: the two structural levels become related by the use of macrorules which semantically map microstructural information with macrostructural information. (Kintsch and van Dijk 1978.)

In interpreting a text, the first task is to establish the microstructure. Various operations are carried out on the microstructure in order to yield its macrostructure. These operations transform the propositions into a set of macropropositions that represent the gist of the text. These operations called macrorules delete or generalize all propositions that are irrelevant or redundant and construct new inferred propositions. The rules are applied under the control of a schema that corresponds to the reader's goals. The schema determines which proposition in the microstructure is relevant or irrelevant to the topic. (Kintsch and van Dijk 1978.)

Even though Kintsch and van Dijk propose an interesting theory and describe the two levels of structures that are intuitively understandable, their basic fault is that both levels are based on one representation. If language users make inferences on the basis of some general background knowledge, that must also be represented in one way or another in their minds so that it can be related to the semantic information. In short, the semantic structures are not a sufficient representation, although it is done at two levels. Thus, a second format of representation is necessarily called for. The theory of mental models has therefore been adopted for the present study.

Johnson-Laird (1983, 380-381), of course, argues against this theory. He shows that the fatal debility concerns claims about co-reference. It is false to assume that if two arguments overlap, they are co-referential. For example, *Roland's wife died in 1928. He married again in 1940. His wife now lives in Spain* contains two propositions about Roland's wife, and thus has an overlap in argument, but is obviously not co-referential. On the other hand, two propositional representations that have no overlap in their argument can be co-referential and refer to the same individual: *the President of the Republic, Mr Koivisto, Manu, the dockyard-worker*. A propositional representation captures the linguistic form of these descriptions, but it cannot simultaneously represent what they refer to. Consequently, a representation of the sense of a text and a representation of its significance including what it refers to is a crucial distinction of the way in which people understand and recall discourse. This distinction is captured in the theory of propositional representations and mental models.

There are other attempts to characterize comprehension on the basis of different levels, but they usually rely on linguistic representation. For example, Noizet and Bastien (1976; Noizet 1980) have formalized the psycholinguistic processing of sentences. Their idea is that the speaker must carry out a number of operations, which are cognitively specific to some extent, but which are not attributed to language only. Those operations show logical properties which specify and constrain the conditions of use. The additional hypothesis is that the operations manifest themselves as relations in the structure of sentences and that each relation is to be linked to a class of rules of grammar. The formalisation does not present a model of the subject. It serves as a descriptive model of complex sentences, but in terms of operations which are nearer to the speaker's functioning than to the linguistic operations (Noizet 1980, 166).

Noizet (1980) reports experiments that he and his collaborators conducted in order to test the psycholinguistic relevance of the formalisation. The central question of psycholinguistics concerns the indications of syntactic complexity. Noizet's formalisation relies on calculating three indications of complexity: the degree of the structure, i.e., the number of connecting core structures; its completeness, i.e., the number of operations; and its hierachical level, i.e., the number of levels at which the structure is analyzed. The experiments conducted show that the number of levels is a good predictor of the difficulty of processing.

In order to understand a sentence, Noizet (1980, 134-135) assumes that a speaker must elaborate a hypothesis on the basis of the relations between the constituents of the sentence, that is, he constructs a representation. Here, Noizet evidently agrees with Johnson-Laird's view that the speaker builds himself a model. However, Noizet's formalisation does not account for the level of comprehending how things are in the world. The linguistic representation, even described as levels of complexity, does not explain how people can think and make inferences. Therefore, Johnson-Laird's theory offers a more promising alternative.

There is a vast body of empirical research within the field of propositional analysis. The results have been rewarding and seem to corroborate the theoretical approach. The problem with interpreting the study results is that they often rely on various deductive and inductive inferences that are not caught in the theoretical framework of propositions. Language understanding is based on one type of representation but the results are interpreted in terms of more than one representation. A recent Finnish investigation by Leena Laurinen (1985) may exemplify this. Some of the scholars seem to be aware of the inadequacy of propositions to serve as all-purpose representations and to represent *the* meaning completely (van Dijk and Kintsch 1983). Recently, J.R Anderson (1983) has also given up his claim for one-type representation by describing a tri-code theory of knowledge representation. The theory assumes three codes or representational types: a temporal string, which encodes the order of a set of items; a spatial image, which encodes spatial configuration; and an abstract proposition, which encodes meaning (Anderson 1983, 45).

Since only Johnson-Laird's theory of mental models is so far the most advanced elucidation of understanding language, we shall build our treatment of thinking in a foreign language on it. The long elaboration of his theory has given the theoretical framework and theoretical tools for treating and developing the main theme of this study in a relevant way. Since thinking in the form of making implicit inferences in natural language serves as a basis for the development of thinking in a foreign language, the next chapters will penetrate the problems of mastering a foreign language and of how thinking in the native language and a foreign language are related.

8. Thinking in a foreign language

If human beings do not employ the formal rules of a mental logic, but employ mental models in order to make inferences and to think, the conclusion will certainly have implications for views of using a foreign language in communication as well as for views of how foreign languages are learnt. One of the problems concerns the question of how people think when they use a foreign language in communication. It has been supposed that in understanding and speaking a foreign language, a person thinks in that language. On the other hand, there are views for the claim that such a person thinks through his native language. The issue concerns the question of how the native language and the particular foreign language are related in verbal thinking. An answer to this will also clarify our conceptions of what a foreign language learner must learn and what his developmental curve is like in order to communicate in the foreign language. The conclusions will also have implications for teaching when learning takes place in schools. First, we shall discuss how thinking in a foreign language is possible. The later sections will take up the problem from the viewpoint of developing and achieving proficiency in a foreign language.

8.1. How is thinking possible in terms of mental models?

We have seen how reasoning can be explained by the theory of mental models. In understanding a foreign-language discourse, the listener must construct a single mental model of it. Comprehension is based on three stages, which employ three types of representation. In reasoning, the vital question is of the contents of the representations. Thus, the key issue concerns to what extent the representations depend on language and how much they encode linguistic matter. On the basis of that, it is possible to assess the relationship between the native and the foreign language and how they function in the process of comprehension.

Since thinking presupposes the real comprehension of discourse and the construction of a single mental model, we must start from the models. Johnson-Laird claims that mental models encode little or no linguistic material. But the content captured in a mental model — its significance — is a function of both the model and the processes that evaluate it. This means that the evaluative processes must embrace linguistic material from the propositional representation. Thus, the outcome of comprehension, the constructed mental model, cannot be free from the influence of the language, even though the model itself does not use a linguistic notation.

It may be a correct interpretation, but the matter can be further elucidated if we follow the ontological characterization given by Johnson-Laird (1983, 410-419). Mental models may take many forms and serve many purposes, which makes their contents vary: there are tokens that represent individuals and identities between them, spatial relations between entities, temporal or causal relations between events, a rich imaginary model of the world to compute the projective relations required for an image. One way to construct an ontology is to consider the concepts that underlie the meanings of everyday expressions. Accordingly, there are things and substances, their properties and relations between them.

The conceptual primitives on which all mental models are constructed are innate. This does not imply that we have to accept the nativist position (Fodor 1975; Chomsky 1965, for example), because a distinction must be drawn between primitive concepts and acquired concepts. The nativist claim is true of the former type, but not true of the latter type. The meanings of semantically simple words consist of semantic primitives, as in the procedural representation of the expression *on the left*. The meanings of semantically complex words are also composed from such primitives, acquired from the meanings of semantically simple words. Miller and Johnson-Laird's (1976) lexical analysis leads to a constraint on the nature and organization of semantic primitives, and likewise on the constituents of mental models. A finite set of conceptual primitives gives rise to a corresponding set of semantic fields, and a finite set of semantic operators in every semantic field serves to build up more complex concepts out of the underlying primitives. The semantic fields revealed by the analysis include shape, colour, person, kinship, motion, perception, cogitation, emotion, bodily action, possession and communication. The semantic operators include concepts of time, space, possibility, permissibility, causation, and intention. These semantic operators provide the framework around which we organize the general knowledge underlying the plausibility of discourse. Semantic fields provide us with our conception of what exists and the semantic operators provide us with with our concept of the various relations that may inhere between these objects.

If we accept Johnson-Laird's account, we may let it serve as a basis for the development of our train of thought. Since the framework is based on the conceptual primitives that are innate, we can assume that it is universal and independent of a particular natural language. Thus, this common basis is one of the basic preconditions that people can verbally communicate and understand each other, despite the vast linguistic differences at a more superficial level. The universal core must merely concern the form of mental models. The universal framework directly constraints the form of mental models more than their contents. Within the framework, each language society has built up a system of mental models that varies to some extent in contents from society to society. This becomes evident when we think of the structure of mental models. The claim that every element in a mental model, including its structural relations should play a symbolic role, together with other arguments, led Johnson-Laird (1983, 419) to draw the conclusion that the structures of mental models are identical to the states of affairs, whether perceived or conceived, that the models represent.

From the above constraint we can make the inference that both perception and conception are influenced by meaning. In principle, human beings are capable of observing the same objects and things, but because they attach meaning to their perceptions, we may believe that perceptions vary somewhat in different language societies. If we think that perceptions have real-world correlates as objects, we might assume that the existent objects provide human beings with a fairly common core of perceptions. Nevertheless, when it is important for a particular society to specify a certain perception, perceptions become differentiated. Hence, the reference in a mental model also differs, and references in different societies differ. Here we notice that reference is an epistemic concept. Although it ultimately may have a correlate in the real world, it is not, strictly speaking, the same correlate that different semantic systems employ. If even perceptions may become different in various ways in different societies, that is more likely to concern conceptions that do not have objects but things, properties and their relations as real-world correlates. Therefore, in more general terms, we can say that the significance of discourse, i.e. truth, is a semantic concept that depends to some extent on the meaning system in which it is used, that is, on the mental models of a given society.

The above discussion has taken up merely differences among perceptions and conceptions in different societies. But generally speaking, it must be a fact that there are more similarities than differences. Otherwise, it is hard to understand that people from different societies speaking different languages or the same language with various degrees of mastery do comprehend each other relatively easily. This would imply that diffences in mental models can be explained by lack of certain perceptions or conceptions or by a varying degree of their specification. Most of the perceptible and conceivable world is common to most human beings. In addition, they share the same conceptual primitives and the framework of semantic fields and operators. Therefore, because of these constraints on mental models it is no wonder that mental models are more similar than different in different cultures.

In communicating in a foreign language, people need to construct mental models. Do they then construct the same models as they do in speaking their mother tongue or have they acquired a new system of models along with the foreign language? The answer seems fairly evident to me. People cannot learn a foreign language without relying on the mental models they already possess. How could it be possible not to perceive or conceive what one has once learnt? It is just the representational system that enables one to learn a new language. On the basis of only a few foreign words, one can guess what is meant just because one is able to construct a mental model of a discourse that looks or sounds incomprehensible.

We may imagine that learning a new language should also require a new system of states of affairs, but it is an absurd idea. Mental models are not an attribute to a natural language which are changed along with the language. They are an inherent part of the human cognitive system which cannot be abolished voluntarily. We can delete neither our native language nor mental models. So, both are at one's disposal, even though not always to advantage, in terms of the foreign language. We have seen that intensions may vary from language to language and, in addition, that the intentions of words are not autonomous but dependent on their truth conditions. Therefore, we may ask how mental models can cope with these differences between the native and the foreign language.

The acquired mental models must be the ground on which the differences are built. There seem to be two main sorts of differences. First, the perceptions and conceptions that do not exist in one's society or have not been experienced before require the construction of a completely new model. I do not think this is very different from acquiring new knowledge in general. Secondly, there are the cases where the previous perceptions and conceptions differ in the two languages. Then the mental models require either more specification or modification, depending on how the meanings differ. If the native language expression is more general than the corresponding foreign language expression, then specification is needed with regard to the foreign language. If the foreign-language expression is more general, the previous model must be modified. I would conclude that the acquisition of specified or modified mental models resembles the processes of how new concepts are generally acquired.

If it is fairly easy to acquire new mental models, it raises the question of the position of new models in comparison to the previously acquired models. The problem is related to a broader issue that concerns the storage and retrieval of knowledge. As for the models specified by a foreign language, the newly acquired models seem to be less permanent than those acquired in native language learning. An empirical observation may exemplify the matter. The Finnish language does not distinguish between the masculine and the feminine in the third person singular of the personal pronoun *hän*, contrary to most European languages. Nevertheless, even as proficient English speakers, Finns may make an error or lag somewhat in producing *he* and *she* in speaking English. This is evidence of their thinking without the corresponding specification in the mental model.

Another observation may be given to support the view that the mental models required are none other than in comprehending the native language discourse. People who know many foreign languages fluently can understand a discourse without being aware of the language. This may happen, for instance, when several foreign languages are simultaneously used in a room. The multi-language person may follow the discussion in terms of the subject matter without difficulty, and without necessarily recalling what language was employed after a short interval of time. Thus ultimately, at least, the models must be the same for both native and foreign languages. Otherwise, a switch from one language to another would not be that effortless.

The conclusion to be drawn about thinking on the basis of mental models is that, even in communicating in a foreign language, speakers make inferences and think by manipulating the mental models that they have acquired in using their mother tongue. If specified and modified models are employed, it is a matter of proficiency rather than an inherent part of natural thinking. Therefore, thinking propositions at depth in a foreign language does not differ from thinking them in the native language. The influence of the foreign language on thinking comes to be seen nearer the surface level. Before we can discuss it, we must say something about the propositional level.

8.2. Propositional thinking

We have faithfully followed Johnson-Laird's distinction of mental models and propositional representation. The action is natural because the analysis has concentrated on comprehension, which proceeds from an utterance into a mental model. This is how inferencing in natural language has been eludicated. In this discussion, utterances are interpreted in terms of propositions, that is, they are units determined by utterances. But if we think of the production of propositions, we realize that some thinking must precede propositions, which are products of thinking. People think by means of various tools, and obviously, the use of those means can be simultaneous and overlapping. They can all end in propositions, but only through propositional thinking. It is natural to assume a propositional level of thinking which precedes the construction of a proposition. If a proposition is the object of thought, we may think of an object, a thing, a claim, etc. This implies that a proposition is compositional in nature, and can be composed of meanings, whereas propositional thinking does not consist of segmented units. The propositional representation must then be a level that enables people to think propositionally. Propositional thinking cannot, however, be thinking in words, because it is a truism that one often gropes for words after having constructed a proposition.

Johnson-Laird distinguishes the propositional representation, which, he claims, is near the surface level. It is obviously a true claim, but a somewhat more detailed discussion is needed, because it serves as a basis for forming a linguistic utterance. Vygotsky (1962) distinguished two planes of speech: the inner, meaningful, and semantic aspect, and the external, phonetic aspect. They form a true unity but have their own laws of movement. In comparison with external speech, inner speech appears disconnected and incomplete. Vygotsky related inner speech to the child's development, but believed that it later became even more abbreviated and individuated, and was to be regarded as verbal thought, which meant thinking in pure meanings. This seems to me to be the propositional representation at which propositional thinking is performed. Its dependence on the linguistic form is important in terms of foreign language.

Although propositional thinking works in pure meanings without words, those meanings are constructions on the basis of the native-language words. It must be impossible to delete them in learning a new language, so meanings once acquired continue to serve as a basis for thinking. I do not think, however, that words are so far away from propositional thinking, even though it can be claimed that people manipulate pure meanings. An indication of this is the rapid and often effortless retrieval of words in everyday life. The availability of foreign-language words may also appear as easy, and therefore, it remains to be shown if it is so. This does not, however, imply that words themselves are employed in propositional thinking. Rather, it proves that foreign-language words are used independently of the native-language words.

Although propositional thinking may be disconnected and fluctuate between different representations, it is likely to rely on mental models as soon as a ready proposition has been constructed. The next phase is to put the proposition into words, and then the linguistic tools of the language also come on the scene. This will concern both the native and the foreign language similarly. The conclusion about propositional thinking is that it probably works independently of words, so that it is, in principle, irrelevant whether the utterance was or will be in the native language or in the foreign language, depending on comprehension or production respectively. The hypothesis concerns unproblematic comprehension or production, that is, the meaning of an expression does not cause any trouble. The conclusion we have drawn suggests that the linguistic forms are not actually part of thought, i.e., in terms of propositions.

If propositions are thought in meanings originating from the native language, it raises the question of the influence of foreign-language meanings on that thinking. I think the picture is much the same as was argued for in connexion with mental models. The possession of meanings acquired through the native language cannot be deleted. Neither is it assumable to have another propositional representation for foreign-language meanings. Therefore, new meanings are likely to be acquired as any new concept or knowledge. The meanings that a person already has in his possession must be specified or modified with regard to the foreign-language meanings. New meanings that have been properly internalized are likely to be part of propositional thinking, whereas it remains to be shown whether this happens to specified and modified meanings. The diversified development is based on the inhibitive effect of the previous meaning. On the whole, the integration of foreign-language meanings into propositional thinking is hypothesizing without much support from empirical evidence, because the investigation into this is still in its infancy.

The negligible interference from the linguistic surface level suggests that propositions are thought without the linguistic elements, although thoughts can be put into linguistic expressions. This would indicate that, strictly speaking, it is not possible to think in English, Finnish, Swedish, or any other language. A similar conclusion is also drawn by Leontiev (1981, 108). The indeterminacy of linguistic expressions supports the conclusion. Also, people may communicate adequately even though they do not share the exact meanings in their thinking, and they need not even be aware of the inexactness. If we cannot be sure that the native speakers think similar meanings, the same is more readily true of foreign-language speakers. In practice, the similitudes of meanings are only questioned in communication breakdowns.

Words, syntax, morphemes, and phonemes as forms of the expressive tools must somehow be represented in the mind too. Their analysis is beyond the scope of this paper. Only the meaning aspect of these tools is relevant to thinking propositions. If we assume that the representation of propositions comes close to the format of the expressive level in terms of meaning, syntactic and morphological structures are likely to play their part in understanding and producing propositions. If this format is internalized in the native language, it is likely to interfere in comprehending but, particularly, in producing foreign language utterances. If we accept the assumption that people decode meanings rather than forms, it is reasonable to hypothesize that the linguistic forms are represented separately from propositional representation.

In preparing an utterance one faces the problem of the forms of linguistic tools. Since languages differ most in their forms of expressions, they have least in common at this level. If the forms of linguistic expressions are represented separately from the propositional representation, the same is true of the foreign-language forms. The separate representations for propositions and linguistic forms as well as the distinct forms between languages lead us to assume that no comparison is likely to be made between the linguistic forms of the two languages in production, either. The whole problem area of linguistic forms is actually related to being in possession of a foreign-language arsenal for communication. The question is intimately connected with proficiency in a foreign language and with the problem of how it is achieved.

9. Proficiency in a foreign language

Conceptually, it is possible to think that a person who knows a foreign language perfectly makes inferences in a similar way to the native speaker in speaking the foreign language. Such a person is fully bilingual, and he would hardly regard either of his languages as a foreign or a second one. Such a perfect mastery presupposes that both languages have been acquired simultaneously, with a beginning in early childhood. Acquisition of each language takes place independently of one another, and the person processes them separately; in other words, he acquires different systems of mental models and he does not mix the propositional representations between the languages. Neither of the languages is operated through the other. Is such bilingualism possible?

In terms of mental models, the idea seems absurd because a person cannot perceive the same thing differently according to the different languages. Propositions would have to be mapped into different mental models, and so on. If the processes were separate, it would leave the bilingual in a curious predicament in that "he would have great difficulty in 'communicating' with himself. Whenever he switched languages he would have difficulty in explaining in L2 what he had heard or said in L1" (Macnamara 1970). In addition, the hypothesis presupposes a complete separation of thought and language. As a consequence of these implications, we must state that it is impossible for a human being to have two completely distinct systems of thinking connected with two different natural languages. The conditions of the concept of bilingualism must be qualified. A common core of thinking related to one of the languages underlies both linguistic systems of the surface level.

There have been practical enterprises of making a child bilingual from infancy on by having two persons as the sources of the languages. The outcomes vary, which is only natural due to many uncontrollable contributing factors. The child may acquire both languages equally well, and the observations may give evidence of perfect mastery. Nevertheless, the meanings of one of the languages must be dominant in deeper thinking so that specifications and modifications in propositional thinking and mental models are made with regard to it. One point is also important: the meanings are not stable but are developed gradually, which increases the unpredictability of the result. Some individual characteristics and environmental factors tend to influence the child's performance in a way that is not wholly predictable. In families in Finland where the father, for example, speaks Finnish, and the mother speaks Swedish, the children can become bilingual differently. The girls of the family may have become fully bilingual, whereas the boys have acquired Finnish better than Swedish. This would suggest sex differences, either due to different parental identification, or due to a certain existent difference in the learner characteristics.

We may assume that such a bilingual is tuned to one language or the other according to the communicating partner. He may be deluded himself by the effortless change of the language into believing that he thinks in two different languages. However, his propositional thinking must be dominantly permeated by only one language. The problem can hardly be solved empirically, because rapid and automatic performance does not prove definitively what processes are involved. Experimenters have tried out various ingenious ways in order to solve the problem, but such results are based on the sequential nature of the mental processes. Accordingly, evidence for one view or the other is not quite reliable, because we may assume that some processes work simultaneously. Therefore, it is not possible to know if one of the languages is operationally in the priority position. The theory of mental models suggests that two completely disparate processes are an impossibility.

We must then conclude that thinking in a foreign language does not, in broad terms, differ from thinking in the native language, that is, at the level of making inferences, because the ground is the same that has been acquired in the native language. Roughly speaking, the greatest difference concerns the surface level, and its mastery enables one to think propositions and construct mental models. Thus, a prerequisite for thinking through a foreign language is a knowledge of the linguistically expressive tools of the foreign language. The possession of the knowledge is not sufficient for communication, for one must also be able to put it into use for comprehension and production. This presupposes skills in doing so sufficiently fluently. The knowledge and skills constitute proficiency in a foreign language, without which there is no thinking in a foreign language. Thinking itself is not proficiency; it is only an indication of proficiency. The possibilities to think through a foreign language vary as a function of proficiency in the foreign language.

Proficiency as a perfect mastery of a foreign language, without a single weakness in any of its areas, is a rare phenomenon in practice. Deficiencies may occur in pronunciation, some expressional form of the linguistic code, vocabulary, some aspects of meaning: nuances, intensions, or extensions of expressions. Nevertheless, the person may be fully capable of using the foreign language naturally and fluently, so that he is not even aware himself of his weaknesses. A perfect performance in daily life is usually based on functional or practical perfection, so that the criterion for practical perfection is not grounded in the function of some inner mental processes. In terms of thinking, only those deficiciences that impede natural inferencing are relevant. In comprehending, weaknesses in acoustic knowledge or in word forms and meanings are evident obstacles for thinking. For production, thinking is not hindered until the propositions must be formulated in the foreign-language code. Thinking through the foreign language is thus asymmetric with regard to representational levels. Hence, thinking in a foreign language is not a sufficient condition for proficiency, but it can be considered a necessary one, because a proficiency which does not enable one to make inferences is of no value for communication.

So far we have regarded thinking through the foreign language only in terms of an individual, but in communication he and his thinking are dependent on the interlocutor's performance as well. Thus, comprehension may be viewed in terms of an outcome or in terms of a process. Communication is successful if the person has comprehended the interlocutor's discourse, i.e. the states of affairs intended by the locutor. The outcome is not fully predictable, because, strictly speaking, the locutor's states of affairs in the form of mental models are not the same as those the interlocutor constructs in comprehending the discourse. A potential discrepancy is caused by a number of various factors: internal, external, or personal ones. However, the models must be of such similarity that both locutors agree upon them. In practice, the criterion of the intersubjective similarity between models is based on functional relevance. If both locutors think they understand each other's discourse, communication is successful and satisfactory for practical purposes. Besides, misunderstandings may be clarified in the course of conversation.

Successful communication cannot only be a function of the interlocutors' subjective and mutual agreement, but it must be based on certain facts that they can share in order to find similarities. The most important factors are the common linguistic form, meaning, common knowledge related to common experiences, and the human system of mental models. However, these factual things do not directly produce understanding, but contribute to the inferences to be made on their basis. Thus, erroneous interpretations are possible, because so much ambiguousness and vagueness occurs in verbal communication. As a matter of fact, it is a wonder that successful communication occurs as frequently as it does. This applies to the native as well as the foreign language, even though imprecision is likely to be accentuated when a foreign language is used. Since the concept of comprehension raises a whole number of conceptual and empirical questions that call for examination from different perspectives, it is wise to keep the concept unproblematic and thus regard comprehension as a plausible outcome.

9.1. Thinking processes with foreign language

It is obvious that the processes by which foreign language discourse is understood are not basically different from those required for comprehending discourse in the native language. If a person constructs a single mental model of the discourse in understanding it, this assumption can be made of a fluent foreign language speaker as well. It presupposes that the person is adequately proficient in functioning in the relevant foreign language. There is no reason to assume that the single mental model is radically dissimilar to that which a native speaker should construct of the same discourse normally; that is, normally, in the sense of what is possible in normal circumstances. This means that the person is capable of making the implicit inferences necessary for comprehending the foreign language discourse.

The interpretation of discourse is assumed to depend on the model and the processes that construct, extend, and evaluate it. The processes in themselves are hardly different in interpreting foreign language discourse, but what is processed is likely to be different stuff to some extent, and also, processing is evidently a more complex affair, and consequently demands more time. The assumption that the vocabularies of different languages are kept separately in memory should, in principle, make them equally available, but the foreign-language expressions seem to be less easily retrievable. This is a generalized statement, and it is possible that the words that are mastered really well are as equally available as the native-language words. Factors contributing to differences between native-language and foreign-language processing must be related to the specified and modified schemata of foreign-language meanings. In fact, there is no guarantee that the mental models really are fully similar. It is likely for them to be slightly influenced by the propositional representation originating from the native language.

Everyday experience might lead us to accept the assumption that a foreign language speaker who constructs a mental model on the basis of the propositional representation processes it with the same effort as a native speaker if he knows the intensions and extensions of the foreign language expressions, and recognizes them in a particular context without difficulty. This seeming similarity is most probaly cheating. There are good grounds to think that more processing is needed, because the non-native masters the linguistic knowledge at a more superficial level than a native speaker. This is evidenced by the rapid deterioration of proficiency, due to the lack of using the foreign language — a phenomenon that does not happen to the native speaker to the same extent, or equally fast. Experience also shows that a foreign language speaker is not automatic in any given discourse, but only in contexts which employ linguistic material that he has practised and that he is used to.

There is some research evidence of more processing with a second language. Dornic (1979), who reviewed a series of studies using speed of processing as a measure of automaticity in bilingual subjects, found that speed increases as a function of experience with language. This was true with respect to both decoding and encoding efficiency. The semantic content of words tended to be decoded more slowly in the second language, and typically, the subjects' ability to encode information in the second language (as measured by naming latencies) was inferior to performance in the first language. Presumably the second language had not attained the degree of automaticity that characterizes the first, even in the case of subjects who are overtly balanced bilinguals.

In a cross-sectional study of 13- to 18-year-old German-Swedish bilinguals, Magiste (1979) found that it took a somewhat shorter time to develop proficiency in the decoding than in the encoding process of a second language. In her research, reaction time measures to verbal stimuli were used to assess both decoding and encoding ability. Monolingual subjects reacted faster, especially in encoding tasks, than bilinguals in their second language. Therefore, Magiste hypothesizes that the poorer performance of bilinguals is due to their failure to achieve the same levels of automatic familiarity with the words of their second language as monolinguals.

What also speaks for more processing is the observation that using a foreign language makes people tired more easily than using their native language. This indicates that they must make more efforts to speak and to comprehend a foreign language. The knowledge of the language seems directly to have an effect on how strenuous the effort is. Even though the person has become fluent in a foreign language, and is not aware of the effort, more processing, in comparison with comprehending in the native language, is unlikely to disappear from the performance. Automatization seems to be more vulnerable in a foreign language than in the native language. Conscious attention, in the form of inferencing and monitoring, is required in foreign-language performance more easily than in native-language performance.

On the other hand, a native speaker who is not very literate may also have to process the linguistic material for a longer time, because he is puzzled at some expressions and has to grope for their meanings. This might serve as a counter-example to the longer processing time of the foreign language speaker. However, a native speaker who has an average or better ability to process linguistic material should be equally good at foreign language discourse, which does not seem to be the case, despite his fluency in the foreign language. Hence, we may draw the conclusion that fluency and automaticity at the practical level should not be equalized with the rate and amount of mental processing.

The rapid decline in automaticity and fluency of the foreign language suggests that it is more dependent on learning and practice than native-language proficiency. This means that the traces of the foreign-language code in the memory storage are not so permanent as those of the native language, or that the knowledge of the foreign-language expressions cannot be retrieved as easily as that of the native language. In either case, more processing is required for the use of the foreign language, which thus seems to have a weaker position in human mentality. Only the native language appears to be so firmly and permanently stored that it is not easily deteriorated, apart from some injuries to the brain.

The disadvantages taken up seem to speak for greater differences in mastering the linguistic material of the native language and the foreign language. But, is all that ultimately related to learning and practice? Even native speakers do not master all the expressions of their native language, because their number is so large and varies so much. There are various forms and possible variants, and even some symbols of similar form include such varied meanings that a normal speaker scarcely knows them all. This would indicate that concepts and linguistic forms are outcomes from learning and practice. More learning also produces qualitatively different schemata for certain concepts, so that even the native speaker may have to make efforts in order to understand the significance of certain types of discourse. Despite these observations, I would not be inclined to compile all language learning under the same processes. Acquiring native language appears to leave such permanent traces on human mentality that its acquisition and learning a language in a later phase might be considered fundamentally different processes.

The implication for the foreign language learner is that he is in a weaker position than the native speaker of the same language. Meaning is of such complexity that the complete acquisition of a foreign-language code is practically impossible for anyone having once learnt his native language. Meaning is not merely a function of a word in isolation, and even words and expressions have no one-to-one correspondence between one language and another. Therefore, it is highly unlikely that any foreign language speaker knows the foreign language as well as an equally educated person who speaks it as native language. Another factor deteriorates his chances in comparison with the native speaker: the foreign language code is more weakly represented and stored in his mind and memory. The only conclusion to be drawn from more processing, incomplete knowledge of the foreign language code, and weaker representation and storage, will be that comprehending a foreign-language discourse differs to some extent from comprehending it in the native language, even in seemingly fluent performance. And the difference is mainly centred on the linguistic code and its representation.

A person who knows several languages may make inferences, conclusions and decisions, and still grope for suitable expressions in his native language, even though he may find an appropriate expression in another foreign language. Does this then mean that he thinks in the other languages, but not in his native language? In other words, is it a counter-example to the claim that propositional thinking is basically of the native-language format? Such a conclusion seems unrealistic. In a foreign-language atmosphere, in a concrete situation, or in reading a book or watching a film, he may be attuned to the language so that expressions of the relevant foreign language occur with more ease. But it is not evidence of his thinking in the particular language. Rather, the person mastering several languages has a richer arsenal of expressions available, and a foreign language may momentarily offer a more suitable expression than his native language.

Practical experience appears to indicate that fluent foreign language speakers are more conscious of linguistic expressions, on the whole, and are more keen on finding suitable expressions from among the languages they know. This does not necessarily mean that they mix up the expressions of the different languages, but that they are aware of more or less suitable variants in another language. This possibility of considering the different languages can be seen as an indication of the need to account for the common basis of thinking through all those languages. The common core consists in the mental models that take states of affairs into account. Hence, it is not an unambiguous claim that a person thinks in a foreign language. Rather, his thinking partly works in the same way irrespective of the language, and partly his thinking is constrained by the expressions of the language he is attuned to.

9.2. Thinking with imperfect proficiency in a foreign language

We have above discussed thinking in terms of practically perfect proficiency in a foreign language. In most cases, people's knowledge and their skills are under development, and still they are capable of communicating in the foreign language. We noted above that proficiency is a necessary condition for thinking through a foreign language. In addition, sufficient fluency in manipulating the linguistic material was presupposed for thinking to be possible. In this section, we shall discuss thinking when language proficiency is deficient. The main factors that differentiate such a person's thinking from a native speaker's are his richer arsenal of symbols and meanings belonging to his native language, the foreign language and the possible other foreign languages he knows. There are good grounds for assuming that all these elements may play a part in comprehending a particular foreign language. It is often assumed that interference, for instance, only comes from the native language. But it is quite reasonable to presuppose influence from other languages as well, as does Bouton (1974), for example, in his theory of second language learning.

A foreign language speaker must possess some means by which he can cope with the deficiences that he faces in using the foreign language. There are two main sources of imprecision for him: the natural ambiguousness and vagueness of the linguistic expressions he shares with the native speaker, and the deficient mastery of the foreign language, which occurs in different areas of knowledge and performance. The theory of mental models has been provided to cope with the first type of indeterminacy, and the same applies to the second type as well. Otherwise, we cannot explain his capability of understanding the significance of a foreign-language utterance or discourse that contains unfamiliar expressions. Propositional thinking is naturally involved in this inferencing process. An indication of its native-language format is the fact that the foreign language speaker comprehends discourse, despite some gaps in his knowledge of the foreign language. The principle of compositionality explains why the speaker may guess the missing parts of the foreign-language utterance in building up the meaning of the whole proposition. Empirical findings and everyday experience show that people may understand most of the foreign language discourse, in spite of their limited knowledge of the foreign-language expressions, given that it deals with some topic that they know thoroughly. Topics consist of states of affairs which are represented in the mental models. The theory of mental models thus gets further support from research within the comprehension of a foreign language.

Although it is dangerous to claim and assume too much on the basis of too little information, practical experience suggests that a minimum of grammar is needed for the speaker to understand what foreign-language discourse is about. Of course, this does not cover all occurrences, but on the whole, some rough differentiation between parts of speech seems to be a sufficient condition for a foreign language speaker to understand discourse. As for parsing a foreign language, it is natural to assume that it is done on the basis of the grammar of the foreign langugage. However, in case of difficulties, the speaker is likely to rely on his grammatical knowledge of the native language or other languages if they happen to be related to the particular foreign language.

Most disturbances in comprehension are evidently caused by insufficient knowledge of the meanings of words. Even a fluent foreign language speaker may have trouble in remembering every possible sense of a word. When a speaker has difficulty in comprehending a foreign-language discourse, we can ask what he will do in such a case. A natural assumption suggests that he relies on the schemata of the corresponding native-language meaning. This may be the case of separate words, in particular, if they have an approximate equivalent in the native language, in contrast to more unlikely equivalents between phrasal expressions. Recourse to another foreign language is more probable if it is related to the particular foreign language. Thus, for example, a Finn who knows Swedish and German is more likely to rely on his knowledge of these languages, when speaking or listening to English, than on his knowledge of Finnish, his mother tongue, which does not belong to the same language family. Reliance on another language is, of course, dependent on the person's proficiency in the language.

Since comprehending a foreign language is easier than speaking it, recourse to the native language, or to other related foreign languages, is likely to occur more frequently in speaking and writing than in reading and listening to the foreign language. The meanings of expressions may be generalized on false premises. The comprehension of a foreign language does not lack such features, either, even though detecting them is not always so straightforward. It is worth noting that reliance on the native-language meanings may also produce correct conclusions. If the intensional and extensional aspects happen to coincide in both languages, the outcome will be successful.

We may ask whether it is possible to know how much of the foreign language code one must master in order to comprehend discourse. I do not think there is any conceptual answer, because the interaction between mental models, representations of the native language, and the foreign language as well as other languages cannot be conceptually determined. Empirically, we may get certain probabilities, but their predictability is also restricted, because the relatedness of the languages in question causes unexpected combinations. The problem does not come up when proficiency in a foreign language is measured, because the contributions of each factor need not be determined separately.

If the linguistic material normallly enables the native speaker to construct a single model of a given discourse, the foreign language speaker is frequently faced with the situation where this implicit inferencing is disturbed by unfamiliar expressions and meanings or some uncertainty about meaning. Thus, he is forced to construct alternative models of the states of affairs in order to build up a single mental model of the discourse. The main difference in proficiency between the native speaker and the foreign language speaker concerns the predominance of explicit inferencing in terms of thinking. Operationally expressed, this means that the less a foreign language speaker must rely on explicit inferencing, the better proficiency in the foreign language is. Naturally, this is a relative statement, because the native speaker also makes explicit inferences. Therefore, the foreign language speaker's inferences must be compared with the ratio between the native speaker's implicit and explicit inferences.

A fluent foreign language speaker is obviously capabable of nearly equal performance in comprehension with the native speaker. Nevertheless, it is reasonable to assume that he must monitor the linguistic material more attentively than the native speaker. Therefore, more capacity is needed for processing, which obviously restricts the possibilities of the person's correct inferences. This is not so obvious in a fluent speaker, but becomes conspicuous in less fluent performance. The sense of a word or an expression which is less common will probably give rise to more processing, even though the form and the usual senses are familiar. This then activates the construction of alternative models. Automatic mastery of the foreign languge is most obviously dependent on practice. People who master the language in everyday conversation nearly perfectly may, however, have difficulties with the written language, and the converse may true if practice in speaking is lacking.

Although the foreign language speaker may experience difficulty in understanding discourse, he is not so easily frustrated because he may comprehend most of the discourse. Unlike comprehension, production is more difficult, and adults who cannot express their thoughts in the foreign language usually become really frustrated. Their intellectual capacity to think is radically restricted by their deficient knowledge of the expressive tools of the foreign language. I think this also shows that thinking through a foreign language is fairly independent of the linguistic forms and the representational meanings of the foreign language. Otherwise, it would be hard to explain the vast discrepancy between the comprehension and production of foreign-language discourse.

The conclusion that there is hardly any absolutely perfect mastery of a foreign language is not invalidated, even though there are fluent foreign language speakers. It only shows that a human being learns new skills and can become so proficient that he is capable of functioning automatically enough so as not to pay conscious attention to his actions all the time. I think this functioning ability can be explained by the construction of mental models. If people were merely dependent on a propositional representation of the foreign language, they could not become so quick with making implicit inferences, because they would then need a more thorough knowledge of the foreign language expressions in order to compute their meanings. It seems to me that the ability to acquire a functional knowledge of a foreign language within a reasonable time lies in the tools of mental models and propositional thinking, because only through them can people come to grips with the propositions, without having to have a complete and faultless knowledge of the foreign language.

In the preceding two chapters, we have outlined a theory of thinking in a foreign language. The development is based on Johnson-Laird's theory of mental models, which is meant to account for reasoning and, in particular, natural inferencing that occurs in comprehending discourse. My application of the theory to foreign-language thinking has been presented in a more or less speculative manner. Now it is time to corroborate the ideas by reference to some previous research and by a small-scale empirical investigation. The remaining chapters will take up the problems concerned about the relationship between cognition and language acquisition, and foreign language learning and acquisition, as they are reflected in the research literature. The empirical study attempts to get some insight into thinking in a foreign language by analyzing a set of cloze-test responses.

10. Cognition and language acquisition

The relationship between cognition and language emerges in the views of how children acquire their native language. Psychologists have emphasized the importance of some general cognitive processes underlying language while some linguists have advocated a specific linguistic and innate system that accounts for language acquisition. In the cognitive approach, Cromer (1976) distinguishes two separate issues: there are thoughts, meanings, and intentions, which can be called cognitions, and, on the other hand, there is a related type of notion, which goes to a deeper level and emphasizes the underpinnings of these thoughts or cognitions. These mechanisms may be called cognitive structures.

In reviewing the literature, Rice and Kemper (1984) simplify the issue into mapping problems, following what Eve Clark (1977) suggested. It is assumed that there are two different kinds of knowing, nonlinguistic and linguistic, that are not isomorphic with each other. The child's problem is to accomplish a match between the two, to map one onto the other. On this basis, the direction of influence and the extent of the linkages between language and cognition in current research can be described as five major hypotheses. Some of them are fairly intimately linked to each other, so that the main streams are enough for our purpose, particularly, because the evidence and findings are controversial.

10.1. Strong and weak cognition hypothesis

The strong cognition hypothesis is rooted in Piaget's view that language is part of more general mental representational abilities. The emergence of language is contingent on other representational capacities (Piaget and Inhelder 1969). Cognitive knowledge can be expected to parallel language structurally. The parallel cognitive structures should precede the linguistic ones and be necessary for the development of the linguistic structures. At all stages of development, cognition affects language and not the reverse. At the most advanced stages, language may be a necessary prerequisite for the development of formal operational thinking, but even then the developing cognitive processes only make use of language; they are not determined by it.

There have been numerous attempts to verify this hypothesis. Comparisons have been made between the child's cognitive structures and linguistic structures. For example, Sinclair (1971; Sinclair-de Zwart 1973) argued that prior to his use of language a toddler can order things temporally and spatially; he can categorize objects according to an action and, conversely, he can categorize actions according to an object; and he can relate object and action to new actions. The important thing is, she pointed out, that these cognitive abilities directly parallel the linguistic (grammatical) ones of concatenation, grammatical categories of subject and noun phrase, and the functional grammatical relations of subject and object. (Sinclair 1971.) Child language scholars (Brown 1973, for example) investigated the meanings of children's utterances and observed that these appeared to focus on object-related themes: objects exist, disappear, and recur, as do the actions of objects and people, and the location of objects and people. Even in later combinations of words children stick to the same themes.

Macnamara can be considered a full-blooded representative of the cognitive hypothesis, because he argues that cognition is not only prerequisite to but also accounts for children's linguistic acquisition, at least those aspects of language that express meaning. Such meanings are worked out on a nonlinguistic basis, in the form of "basic cognitive structures". A baby's main strategy must be to divine the speaker's intention as a clue to language. This position presupposes that he is initially able to use nonlinguistic objects, events, and signals, as a clue to intention far more accurately than he can use speech. Such clues are likely to be objects which are present, the movement of objects, human gestures and eye-to-eye contact. (Macnamara 1972.) Experimental studies that Macnamara (1977b) reports show that if infants can understand linguistic instruction, they respond to it, and largely depend on it, but they can be misled by a look or a gesture. This makes him think that gestures are the more basic and more powerful signalling system.

Eve Clark (1977) argues that children's first words reflect what they have worked out nonlinguistically. Her experiments show that children in early infancy have certain a priori conceptual preferences in terms of dimensionality and spatiality, for example. She then assumes that these preferences happen to match the meanings attached to particular words by the adult and, hence, the child's strategies for dealing with different situations play an important role in acquisition. The child's knowledge about his surroundings appears to be organized in terms of general categories and relations, and what he knows about each. The cognitive principles that the child applies in organizing his knowledge appear to provide the basis for his strategies of interpretation when his mapping of different words is still far from complete.

Likewise, Nelson (1985) assumes that several prelinguistic representational structures form the conceptual basis for word learning. However, she denies the possibility of explaining the acquisition of language merely by cognitive development. Nelson assumes that general event representations embed object representations as well as actions and actors. In interaction with his environment, the child learns to respond to other people's behaviours. This, then, implies that the child has an internal model of the social world that serves to interpret the meanings of words as well as gestures. Therefore, the nature of such mental models must be described adequately in order for us to see how the child can begin to interpret and to use language within them (Nelson 1985, 36). Nelson's term mental model is not employed in the same sense as in Johnson-Laird's theory, because she refuses to take a position as to the mode of the schematic representation, whether it is in terms of an image or propositions or is more abstract than either. For her, there is no implication that a representation is a copy of reality; rather it is a model of experience, and each person's experience of a situation or event will be different (Nelson 1985, 39-40).

On the whole, the strong hypothesis seems to be too extreme a position. It must be an exaggerated view that cognitive structures correspond to linguistic forms. Contrary to the predictions that the Piagetian structures (such as object permanence, means-end, or symbolic play) correlate with performance on language tasks, it has been found that cognitive knowledge does not always precede words or word combinations (Rice and Kemper 1984, 22). However, findings that the cognitions of general categories and relations precede meanings seem to support the theory of mental models, because they are assumed to originate from the development of perception. Nevertheless, I am suspicious of the view that children first learn meanings nonlinguistically and then let those meanings direct the search for linguistic expression. Therefore, we have to discuss alternative approaches.

The above discussion about the relationship between cognition and language has primarily focussed on the expression of meaning. There are, however, scholars who argue that, even if cognition accounts for meanings, it does not entail an account of the whole of language. Cromer (1976), for example, suggests a "weak form" of the cognitive hypothesis, because in addition to cognitive structures and operations and cognitions we must also possess certain specifically linguistic capabilities in order to express meanings in language. Likewise, Slobin (1973) suggests that cross-linguistic differences allow for the inference of language-processing principles that are independent of cognition. After reviewing different data, Wode (1981, 28) also concludes that within man's overall cognitive abilities, there must be a subtype geared especially to the acquisition of the formal properties of the linguistic devices used in natural languages. He calls them linguo-cognitive abilities to be distinguished from the conceptual and logico-cognitive ones. Typically, these views also include the assumption that the linguistic devices are more or less innate. This is explicitly stated by Slobin (1973, 76-77), but also, Cromer believes in innateness, even though not in the Chomskyan form.

10.2. Interaction hypothesis

Contrary to the one-way direction of influence from cognition to language, there are standpoints which hold that linguistic expressions can alter the nature of children's cognitive development. Those who argue for early bidirectional influence between cognition and language may be said to support the interaction hypothesis. They may take different interpretations of interactive influences, but ultimately, the hypothesis dates back to Vygotsky (1962), who emphasized the social context of children's early communication. He distinguished preintellectual and prelinguistic development, which spring from two different genetic roots but meet and join at a certain age. Before that turning point, the child recognizes a small number of words which substitute, just as in conditioning, for objects, persons, actions, states, or desires. He has got the words from other people, but at the turning point, he becomes an active learner and needs words to attach signs to objects. The lines of speech and thought development have met when he has discovered the symbolic function of words. (Vygotsky 1962, 41-43.)

Vygotsky's conception contrasts with Piaget's, because Piaget regarded children's first words as symbols for communicating what they already know. He focussed on the child's individual, cognitive sources of knowledge instead of the social context of communication. Piaget described several kinds of behaviour as evidence of the attainment of mental representation, such as deferred imitation, symbolic play, and search for hidden objects. The child's personal discovery of mental representation provides him with stored meanings and an appreciation of how symbols can represent them. Such understandings allow a child to look for gestures and, later on, words to express his meanings. (Rice and Kemper 1984, 31.)

Contemporary, microanalytic descriptions of infants' first communications support the view that the beginnings of reference originate from the interpretations supplied by others, and not from a child's private, personal cognitive discoveries. Children learn that their behaviour has communicative significance from the reactions of others. For example, the fact that a parent ascribes communicative significance to the gesture suggests to the child that the gesture has meaning. Likewise, the parent's tendency to label the objects indicated by the child's gestures provides linguistic models for the child to use later on. (Rice and Kemper 1984, 31.)

Schlesinger's (1977) observation also supports an interaction account: the nonlinguistic meanings that a child has worked out prior to language are not isomorphic with those encoded in language. When the child faces a mapping problem, he is provided with the regularities of language that may serve as the clues to solve the problem. As a consequence, linguistic categories suggest new cognitive categories, even though the nonlinguistic experience will not automatically provide the distinctions encoded in language. The regularities of language establish the relevant category boundaries, categories that may not have occurred to a child otherwise. Along similar lines, Vygotsky (1962, 68) described how language influences the child's thought: "The language of the environment, with its stable, permanent meanings, points the way that the child's generalizations will take. But, constrained as it is, the child's thinking proceeds along this preordained path in the manner peculiar to his level of intellectual development."

As a matter of fact, Schlesinger's (1982) argumentation challenges the strong cognition hypothesis in asserting that language stabilizes cognition by providing a stable inventory of basic categories and operations. The similarities in the coding of categories across languages are a consequence of the perceptual regularity of the world, a "texture," that "constrains but does not fully determine the formation of concepts" (p. 146). The differences across languages reflect the options within the texture. The texture accounts for children's ease of word acquisition.

Schlesinger seems to share with Vygotsky the view that children do not acquire word meanings in their final concepts but develop and refine their meanings gradually. Children's first categories are tentative sortings within the options provided by the perceptual regularities, because they do not become permanent until they are "firmly anchored to relatively invariant linguistic responses" (Schlesinger 1982, 146). Vygotsky writes similarly: "The relation between thought and word is a living process; thought is a dead thing, and a thought unembodied in words remains a shadow. The connection between them, however, is not a preformed and constant one. It emerges in the course of development, and itself evolves" (Vygotsky 1962, 153).

The interaction hypothesis seems to be in accordance with the theory of mental models and propositional representations, because cognitive development and speech development are first separated and then seen to join in the interaction of perception and language. As we have noted, comprehension may remain at the propositional level, and only by a deeper elaboration can people construct mental models. The developmental description of how interaction is possible supports the separation of propositional representation from mental models. Also, the development of word meanings supports procedural semantics, because meaning cannot be directly assigned to objects and things but is a work of construction. If the strong hypothesis were right, it would entail a similar categorization across languages. But despite many similarities, there are differences as well, so that linguistic influence must also be taken into account.

The interaction hypothesis also clarifies the Whorfian hypothesis which asserts that language determines perceptions and thought. The evident differences across languages do not, however, determine the perceptual processes, though perceptions can be named after the language categories. Professor F. Mackey has interestingly elucidated the Whorfian hypothesis in his contribution to the discussion of Macnamara's (1970) paper. According to him, it contains two hypotheses, one of which we can accept without accepting the other. The first concerns relativity, linguistic relativity, which means that languages slice up reality in a different way. This becomes evident to anyone who translates from one language to another. The other hypothesis refers to determinism, which says that, because languages do slice up things in different ways, people speaking them are forced to think in different ways. It is this that we so strongly oppose, so that the relativity of the hypothesis can be accepted but not the determinism part of it. This interpretation is also in congruence with the interaction hypothesis.

Recently, Katherine Nelson (1985) has developed her theory of making sense, which seems to combine different approaches when she claims that "a theory of semantic development must deal with three problems: the communicative context within which meaning is expressed and learned; the child's cognitive system, which interprets and intends meaning; and development — cognitive, linguistic, social — which changes the parameters of the system throughout the period." (Nelson 1985, 7). The enterprise, however, falls within the domain of the cognition hypothesis, even though it is in a more elaborated form, because it utilizes the knowledge of schemas, events, and so on, that has been developed in the research tradition of propositional representations. Nevertheless, it has no more bearing on the argument of this paper.

In sum, we may state that the theories and conceptions of language acquisition are contradictory and empirical findings controversial. This is partly explained by the mismatch among constructs, methods, and explanations. The relationship between cognition and language may obviously vary as a function of age, linguistic abilities in question, and the type of cognition involved. Therefore, it is a futile attempt to characterize the relationship in global terms. The more lasting findings, however, support the views that we wanted to have corroborated about the relationship between cognition, language, and thinking.

10.3. Inner speech

The above discussion has attempted to find support for the theory of comprehension that we have adopted in this study. One aspect of propositional representation has not been touched upon yet: propositional thinking. I suggested that propositional representation cannot strictly follow the surface structure but must concern the meaning. Support for my suggestion can be found in Vygotsky's conception of inner speech. His hypothesis was developed to account for egocentric speech as a transitional stage in the evolution from vocal to inner speech. This is in contrast to Piaget, who considered that egocentric speech accompanies the child's activity but gradually dies off. Vygotsky, however, observed that, during the period of disappearance, egocentric speech changes qualitatively into a fragmentary and ungrammatical form, although the child's language acquisition should predict the converse. This made Vygotsky hypothesize that egocentric speech gradually became inner speech.

The earliest speech of the child functions as communication and social contact and is global and multifunctional in nature. At a certain age, social or communicative speech can be distinguished from egocentric speech, which emerges when the child transfers social, collaborative forms of behaviour to the sphere of inner-personal psychic functions. Egocentric speech is a transitional link between vocal and inner speech which serves both autistic and logical thinking. Thus, the development of thinking is from the social to the individual, in contrast to Piaget's view of the reverse order. (Vygotsky 1962, 19-20.)

Speech turns inward because its function changes. The child begins to operate with inherent relationships and inner signs. As far as the connection between thought and linguistic processes are concerned, Vygotsky (1962, 47) thinks that, schematically, thought and speech coincide in the overlapping parts of two intersecting circles to produce what is called verbal thought. But that does not by any means include all forms of thought or all forms of speech.

Inner speech develops through a slow accumulation of functional and structural changes. It branches off from the child's external speech simultaneously with the differentiation of the social and the egocentric functions of speech. In the final phase, the speech structures mastered by the child become the basic structures of his thinking. The important thing to note is that thought development is determined by language, i.e., by the linguistic tools of thought and by the sociocultural experience of the child. Hence, the development of logic is contingent on his mastering the social means of thought, that is, language. (Vygotsky 1962, 50-51.)

Vygotsky characterizes inner speech on the basis of observations that have been made about egocentric speech in its gradual process of change. Inner speech is not a copy of external speech without sound. It is functionally separate, and the most peculiar trait is its syntax, which omits the subject of the sentence, together with related words, but preserves the predicate. With the reduction of syntax, meaning comes more to the forefront, but its syntax does not preserve its original form either. In inner speech, we may note the rule that sense predominates over meaning, sentence over word, and context over sentence. Egocentric speech is characterized by agglutination. The child agglutinates words to form compound words and to express complex ideas. In addition, a single word is so saturated with sense that many words are needed to explain it in external speech. Thoughts, unlike speech, do not consist of separate units.

The hypothesis of inner speech and its development provides us with a fascinating and simple solution to the connection between thinking and speech. The account partly explains how children gain their logical thinking. The hypothesis seems to be in harmony with the theory of mental models, and even corroborates it. The logical properties of language become internalized in language acquisition, and this allows natural reasoning without any separate mental logic. If the hypothesis is correct, it also explains why the native language is so deeply rooted in the mind that is hard to eradicate, in comparison with the preservation of foreign languages. Since the native language imprints such permanent traces on the mind, it is understandable that foreign languages are considerably more difficult to acquire than the native language. One would expect a reversed difficulty, because the child's learning task is enormous, and in terms of mental development, qualitatively multifunctional. In comparison with adults, he seems to be less abundantly equipped with experience and different learning strategies.

The hypothesis of inner speech also clarifies the concept of propositional thinking. If it is alienated from external speech, its origin and the present form can explain why it is not far from words without, however, consisting of words, but of combined and complex meanings which constitute propositional thinking. The original connection makes the meanings into those of the native language, rather than those of universal abstractness. If the meaning were fully abstract, its link to the native word and the foreign word should be equally permanent and effortless. Therefore, we may justifiably assume that the native-language format also serves as a basis for propositional thinking in a foreign language.

Previously, we distinguished propositional thinking from the propositional representation that is very close to external speech. But propositional thinking or inner speech is likely to approach external speech as well, in particular, when it serves as preparation for it. Then, we may assume that thought has been formed into a proposition with the linguistic tools available. In this phase, a foreign language speaker must also have found the expressive tools. For him, we might regard this phase as propositional thinking in the foreign language, because the foreign-language meanings then constitute the propositional representation. In comprehension, this phase is obviously passed through quickly, except in the case of a deficient knowledge of the language.

11. Learning a foreign language

The preceding chapters have attempted to elucidate how it is possible to think in a foreign language. We have noticed that human beings adopt the ability to make inferences in natural language with the acquisition of their mother tongue. The interaction between cognition and language seems to account for language acquisition. As a consequence, we may distinguish at least the two representations required for thinking: mental models and propositional representation. The latter is partly of the native-language format, which must be taken into account in terms of foreign language learning. What remains to be learned for one to think in a foreign language is the knowledge of the foreign-language expressive tools.

In learning a foreign language, it is reasonable to assume that some of the linguistic knowledge is universal in meaning, even though not in form. Thus, for example, connectives and some quantifiers may function similarly across various languages. Once the truth conditions of such expressions have been acquired in the native language, the ability of inferencing can be transferred to a particular foreign language. Since the truth conditions are represented as mental models, these also serve as the basis of thinking in a foreign language. The form and meaning of a foreign language expression is directly associated with the corresponding native language meaning. It is then obvious that the mental models needed for logical thinking are acquired through the native language. These tools then facilitate learning a foreign language. However, there may be some differences in the logical properties of expressions between the native language and the foreign language. It naturally presupposes learning them.

Learning a foreign language must be based on some facts. One of them is that only the native language can be imprinted on human mentality in such a way that it does not easily become unavailable for use. It is probably like the basic format for the representation of language, and once this has been done, it cannot be undone, which means that all languages after this first imprinting will have a weaker representation in the mind. It is quite reasonable to assume that the acquisition of language is comparable to the development of perception in human beings. Thus language acquisition is more a question of maturation than that of conscious learning. Once this has happened, the possibility of changing it will be a futile enterprise.

As an indication of the native language influence, we can mention the attempts to convey meaning monolingually in teaching in order to establish direct associations without the intervention of the native language. But such techniques do not prevent the formation of wrong associations. Apart from some very concrete nouns, it is difficult to demonstrate the great majority of second language words and sentences. Even the clearest pictures tend to elicit a variety of utterances, rather than only the one we want (Pimsleur 1966). In his experiment, Hammerly (1974) used pictures of five concrete objects and instructed 100 university students via audiovisual demonstration with German and Russian words. Despite the very concrete content of the pictures, the number of subjects misinterpreting the pictures or in doubt about their interpretation ranged from 25 to 60 percent. Meanings are not clearly conveyed even by series of contextualized pictures as shown by the experiments conducted by Hammerly (1982, 307). One of the experiments by Dodson (1967, 8-9), involving 30 university lecturers, revealed that subjects shown the frames of complete audiovisual lessons (20 frames per lesson) from materials available on the market at the time were able to guess the meaning of only 10-40 percent of the sentences. Also, it is obvious that visuals are subject to cultural differences, individual differences in ability to interpret the pictures, and technical difficulties in deciding how to represent each word or sentence. In Hammerly's experiment (1974), 70 of the 100 subjects immediately thought of one or more native language equivalents for the foreign word being heard in conjunction with its pictorial representation, and the rest thought of native language equivalents only a brief moment later. The student seems to have what Dodson (1967, 51) called "the eureka experience" of saying to himself "Ah, fenêtre means window".

Accepting the format function of the native language does not hinder us from allowing the growth of native language knowledge. It is only that the grounds of a particular language are imprinted on the mind at a certain age as an interaction of the language of the surroundings and the maturation process. Concept learning is not limited to this phase. It is quite possible and perfectly natural to learn new concepts after the device of learning has been developed.

11.1. A comparison between native language acquisition and foreign language learning

There is much discussion about the similarity and the difference between the processes of acquiring the native language and learning a foreign language. Charles Bouton (1974, 169) has presented a schematic opposition between the acquisition of the native language and the acquitision of the foreign language:

	Native language	Foreign language
Neurophysiological plane	Privileged stages Automatic Voluntary ↓	No privileged stages Voluntary (conscious) Automatic ↓
Psychological plane	Profound motivations	Superficial motivations Inhibitions
Intellectual plane	Experience Language ↓	Language Experience ↓
Linguistic plane	Discourse Language system ↓	Language system Discourse ↓

(Bouton 1974, 169)

At the neurophysiological level, the child profits from the privileged ontogenic stages so that he can use automatic inborn functions.

Voluntary verbal activity controlled by intelligence and organized into complex utterances follows only after the child possesses spontaneous verbal behaviour determined by the situation or his gestural activity. A foreign language that is learned does not have these privileges.

At the psychological level, the child follows his basic and profound needs in acquiring his native language. Through it, he gets a means to satisfy his natural impulsions: to act on his environment and to integrate himself into it, in order to become an individual and a social member of his community. The motivations that a foreign language learner has are superficial and different in kind, because they are either of intellectual character: curiosity, exotism, or of affective character: aim of superiority, pleasure, or quite simply, the foreign language is a compulsory school subject. Learning the new system may cause deep inhibitions because the self-concept is deeply rooted with the mother tongue. A foreign language learner may be feel that his capacity to express his thoughts in the foreign language is strongly limited, and that the linguistic value system is unrealistic to the representation of the world. (Bouton 1974, 167-168.)

In acquiring his mother tongue, the child proceeds from his experience directly to the language. Therefore, the linguistic utterances progressively organize his experiences into a knowledge that he shares with the fellow members of his society and that is mixed with the language. Experience and the linguistic expression are intimately associated as a signification which is deeply integrated into the person's behaviour. All similar or seemingly similar experiences activate the linguistic expression, which then gets a more abstracted position, independent of the primary (initial) experience. (Bouton 1974, 168.)

For a foreign language learner, the procedure is just the other way round. He proceeds from the foreign language to the experience organized by the mother tongue. The learning situation causes a conflict between the two codes. The foreign language expression obtains its significance through the filter of the mother tongue, which reduces the operations of association laws. The deformed operation of this filter must be attenuated through repetition or reinforcement, before the foreign language utterance is given its full signification. (Bouton 1974, 168.)

At the linguistic level, the courses are also inverse for the native language acquisition and the foreign language learning. Discourse behaviour has been formed according to the patterns which the child has experienced in communication. This is the result of his interaction with the environment and the surrounding culture. The language system has been established accordingly. A foreign language learner starts from the language system in order to achieve the discourse level. This procedure obviously follows a certain mechanism. (Bouton 1974, 169.)

Bouton strongly relies on the idea that foreign language learning is based on the mother tongue. From the grounds of the mother tongue, the learner must construct a new pattern of linguistic behaviour, and the former habits must be gradually modified in conformity with the new systems. Bouton (1974, 170) calls this approach techniques of re-education, and not education. These techniques rely on the mechanisms of listening and articulation as well as on the mechanisms of perception and conceptualization, which condition the verbal activity. The major problem that faces us with re-education is the fact that the former fundamentals which every subject masters as his habits are and must be preserved. The habits acquired, together with the mother tongue, cannot be extinguished. Bouton considers that the subject unconsciously forms defence mechanisms against the submission that he is exposed to in his readaptation to the new systems. Those defences that arise manifest themselves as inhibitions, which may have their origins in integrated self-consciousness.

The assumption that Bouton makes may be true, but, on the whole, it seems difficult to accept that all the negative emotional factors can be explained by the defensive mechanisms. It is fully clear that learners are somehow negatively attuned if they cannot learn or remember what they want, and it is also intellectually frustrating to become naive and simple if the arsenal of foreign language expressions is very restricted in scope. It is humiliating to be treated as an invalid, or at least less intellectual, by native speakers who do not understand that intelligent reasoning is less easily demonstrated by means of a deficient foreign language knowledge. Everyone wants to excel in the eyes of others.

If the foreign language is learnt in the same way as the native language is acquired, people should learn the intensions and extensions of the foreign language expressions in the same way. But it is not economical. Although a child learns his native language relatively fast, it is not the knowledge of the whole language he learns, but only its basics. He will learn more and more of his language through all his school years. If he knew the whole language, say, at the age of seven, how can we explain the vast differences that people have in the knowledge of their mother tongue? Even the people who have gone through comprehensive school differ considerably in their language knowledge. So people must learn more and more of their mother tongue all the time. Of course, most of it comes from books and reading, but it shows that a foreign language speaker does not have the same time available, especially if he learns more than one foreign language, which is not so unusual in Europe.

It is worth noting that, relatively speaking, the young child develops precision in the use of his native language gradually and slowly, through interaction in communication. It takes him several years to master the sound system. Similarly, the development of accuracy in grammar is slow, seen from the adult's perspective. It also takes him fairly long to narrow down the meanings of words from their initial very broad semantic fields. (Hammerly 1982, 100-101.) An adult foreign language learner is more efficient in this regard, particularly if he is taught the foreign language.

Learning a foreign language in a natural setting cannot guarantee perfect mastery. A person cannot gain the knowledge of all the intensions and extensions of the foreign language expressions and their use so completely that he might compete with a corresponding native speaker. Fluent as he may be, part of this knowledge can be fake, and he may reveal himself in one context or another. The intensions and extensions of some expressions, in particular or the allocation of mismatching words together, etc., may disclose such spurious knowledge. On the other hand, there are and have been professional writers who express themselves in a foreign language. This might be a counterexample, but we may point out that they can content themselves with the expressions they know very well, or they can always check the language with a native speaker. Despite the irreproachable outcome, they can process the linguistic material with more care and scrutinity than a native speaker, so that it does not distort my basic argument that the foreign language is in the mind more weakly represented than the native language.

The intensions of words are not specified in isolation. We may assume that they are organized taxonomically. Likewise, it may be assumed that the acquisition of intensions is also taxonomic. The intension of a foreign language word is, however, directly associated with the corresponding mother tongue intension. Now whether the two expressions happen to have the same range of meaning, and whether all intensions of the corresponding expressions are the same for the two words is more or less fortuitous. The chanciness of gaining the exact meaning of the foreign language word is increased by the learner's potential associations of the meaning of the word with similar-looking expressions in other foreign languages.

The substance of a foreign language is not a whole which is easy or difficult to acquire, but consists of elements and structures of varied difficulty. The fact is based on experience and empirical generalizations. The morphology seems to be easier than the syntax. A natural explanation might be that there are a lot more and varied syntactic rules than morphological endings. Another seemingly unexhaustive source of difficulty is vocabulary and semantics in a foreign language. It is not only the question of learning them, but also that of their retention and retrieval. There appear differences among people as to how they learn the various aspects of the language. For example, a natural, almost native-like pronunciation is more likely to be achieved if learning is started before puberty. On the other hand, pupils who are a little older become more efficient learners of linguistic material that is based on language processing, inferencing, and regularities.

11.2. Are the native language and the foreign language acquired similarly?

The varying views of the relationship between language and thought have led to different hypotheses about foreign language learning and acquisition. The basic questions concern the similarity of the processes by which we acquire our native language and a foreign language, and the relationship between acquiring a foreign language in natural settings or learning it through teaching. There are various issues related to these main questions, but they will be taken up as far as they are pertinent to my main theme.

In order to structure the discussion, it is wise to use certain terms consequently, even though their conceptual and factual contents are ambiguous and controversial. Wode (1981, 20) distinguishes the following types of language learning and acquisition: L1 monolingualism, L1 bilingualism (multilingualism), naturalistic L2 acquisition (untutored), and foreign language learning (tutored). The concept of L1 bilingualism refers to a situation where two or more languages are acquired simultaneously in early childhood. The other concepts are obvious. Research is carried out within each type, but results from these various fields are often controversial, and it appears hard to build a coherent theory on their basis. In contrast to these diversified trends, the project at Kiel, Germany, aims at a broader perspective, by focussing on the more general problem of how humans at various age levels acquire language(s) in different situations (Felix and Wode 1983, 5).

Attempts have been made to answer the question of the similarity of the acquisition processes for the mother tongue and a foreign language by analyzing children learning two languages. It is considered that crucial evidence to decide this question is whether interference occurs in naturalistic L2 acquisition. Accordingly, the claims can roughly be grouped as identity proposals and interference proposals, to use Wode's (1981, 47) terminology. Those who assert that L1 and L2 acquisition are the same, de-emphasize the influence of interference, whereas the other group emphasizes it, by suggesting interference hypotheses.

Case studies of early bilingualism have concentrated on a few patterns or on a more general description of the development. Leopold (1954) made a careful and monumental study on his daughter's acquisition of English and German. He reports that the child was not really bilingual during the first two years. She combined two models into one speech form. No clash between two sets of patterns occurred in sounds, syntax, or morphology. Compound nouns and verbs were sometimes hybrid; but that, too, does not mean a clash of patterns; the two languages use the same pattern. In later years, the situation changed, when the child became conscious of the bilingualism which faced her, and learned to keep the two languages apart. This struggle to separate two systems is shared by child and adult bilingualism, because in both cases two separate patterns must be mastered, and to keep them separate means a struggle. The natural thing for both children and adults seems to be to operate with one language system, even though the walls between the two systems are brittle until the achievement of separation.

Ravem (1968) observed longitudinally how his two children with Norwegian as their mother tongue acquired English without formal instruction in Great Britain. He focussed primarily on negation, interrogation, and the auxiliaries. He notes parallels as well as differences when English is acquired as the first language. In Los Angeles, Evelyn Hatch (1978) and his collaborators have worked with children, adolescents, and adults learning English with various mother-tongue backgrounds. The structural areas investigated by the group include interrogation, negation, auxiliaries, inflections, some phonology, and L2 discourse, but no theory of L2 acquisition has been suggested.

Hammerly refers to his own investigation (1964) and claims that a careful study of early bilingual development from infancy on shows interference. Even when specific persons and environments are consistently associated with each language in the mind of the child, there is considerable linguistic interaction. In his study, phonological interference was evident until the age of four, grammatical interference until the age of ten, and the two lexicons continued to interact into adulthood (Hammerly 1982, 104). In this light, it is difficult to accept the classical distinction between 'compound' and 'coordinate' bilingualism. Hammerly (1982, 104) rejects the misleading concept of a compound bilingual, who thinks in one language and speaks in another, because, linguistically, he does not lack interference and, psychologically, he does not process directly from thought to expression.

Dulay and Burt (1975) strongly advocate the negligible importance of first language influence on second language learning. Their claim is based on the findings in their experimental studies involving large groups of children. A good remark about the general strategies of acquisition is made by Kennedy and Holmes, commenting on the Dulay and Burt paper. They remind us that all previous learning influences subsequent learning and behaviour and that "this phenomenon can be observed in first language acquisition...and is often called overgeneralization. It is perhaps a pity that a special term 'interference' was used by habit theorists to describe in second language learning behavior that arises from a similar overgeneralization process." (Kennedy and Holmes 1975.)

The above studies speak against the widely held belief that interference is not an important factor for children acquiring two languages, and also for children acquiring second language in naturalistic settings. In contrast to the Dulay and Burt conception, the occurrence of positive transfer and interference from the previously learned language is obvious. These empirical investigations do not clearly define the construct of interference, but roughly speaking, we may consider them mainly to concern the linguistic aspects. Although they do not specifically argue for or against thinking through the first language, I would like to consider the interference of these linguistic aspects as evidence of the impossibility of thinking completely in a foreign language, because only the hypothesis of coordinate bilingualism might support such a view.

Another issue related to the question of the similarity of the acquisition processes of L1 and L2 concerns identical developmental sequences. Kessler (1971) has found that young children acquire the rules of two languages in about the same order. Slobin (1973) claims that unmarked forms emerge first in native language acquisition, and Swain (1976), Tarone et al. (1976), and Adiv (1980), for example, observe the same in second language acquisition. In both cases words (free forms) are acquired before sub-word elements (bound forms). Cazden (1968), R. Brown (1973) and DeVilliers and DeVilliers (1973) report on the acquisition of morphemes by many native language acquirers. The results show approximately the same order of acquisition, apparently determined by both grammatical and semantic complexity.

Heidi Dulay and Marina Burt have used the bilingual syntax measure to elicit speech. A set of cartoons is shown to the subject, who then answers questions about the pictures. They work with cross-sectional samples of a large number of learners and with eleven inflections and grammatical morphemes that they want to elicit from children's speech. They attempt to answer the question of whether L2 children from various L1 backgrounds produce these eleven inflections and grammatical morphemes target-like in the same chronological order, and whether this order conforms to the one exhibited by L1 learners of English. The investigators hypothesized that English as an L2 was acquired in the same sequence irrespective of the L1 previously learned, and report that interference (4.7% of the errors) plays a minor role in L2 acquisition. (Dulay and Burt 1972, 1973, 1974.) This claim of a universal order morpheme acquisition by second language acquirers has, however, been disproved by longitudinal studies such as Hakuta's (1976) and Rosansky's (1976).

Since the rank order of error-frequency in the second language differed from that in the first language, Dulay and Burt concluded that children did not repeat the process of the first language acquisition with a new set of data but could creatively apply to the second language such conclusions about language structuring that they had made in the first language acquisition. The investigators suggested that children are endowed with a universal cognitive mechanism that allows them to acquire second languages, and called this mechanism the creative construction process. The same conclusion was drawn by Susan Ervin-Tripp (1974), who claimed that the acquisition processes must be the same for learners of L1 and L2 because both groups made similar types of errors and the first language could be shown not to be the source of the second language errors.

The Kiel project includes all types of language acquisition, with the aim of characterizing man's overall capacity for language acquisition. It has so far focussed on the linguistic structure of learner utterances. All studies are longitudinal. A methodological emphasis is put on the developmental sequences rather than on morpheme order. The structural areas that have been examined include negation, interrogation, inflections, and phonology including intonation. Wode (1981, 45) summarizes the main results. Some acquisitional regularities are peculiar to individual acquisitional types, whereas other regularities recur in all types so far investigated. The variables that determine the linguistic structure of the learner's utterances are the formal properties of linguistic devices: word order, free versus bound form, segmental versus suprasegmental marking, embedding, etc. Wode links these to the view that the human brain is equipped with specific cognitive abilities that allow man to process such formal properties and to operate with them. These language processing abilities must be distinguished from conceptual cognition. Wode concludes that language processing and the language acquisitional abilities seem to function on a categorical rather than a gradient basis.

Despite the findings that have been made in favour of the parallel surface structures in language acquisition, I do not think they tell the whole truth. Besides some divergent results, methodological and statistical criticism may be directed at the studies, because they rely on group measures, which delete individual differences from the data. Although some developmental structures may be considered parallel, it does not entail their occurrence at the same stages in the developmental sequence. Besides, some native-language interference has been observed in all studies. Also, Wode (1981, 48) concludes, based on research, that it cannot be assumed that L1 and L2 acquisition is parallel in terms of identical developmental sequences. Parallelism may only lie in the fact that both L1 and L2 learners employ the same strategies and processes, but they yield different developmental sequences due to differences in the total setting, like cognitive maturity and situational variables.

One important field that might help to understand language acquisition is neurophysiology. In addition to its remarkable results, it has also produced much disputed evidence of language acquisition. According to Lamendella (1977), the child's capacity for primary language learning develops in discrete increments as a result of the sequential maturation of autonomous neural systems at several levels of brain organization. Immature neural systems carrying out language functions are integrated into the maturational schedule as a whole. Within a given developmental stage of a given neurofunctional system, there arise infrastages that reflect the construction by that system of learned information frames and skill schemata that may be labelled infrasystems. Infrasystems are functional constructs of brain systems derived in relation to particular environmental experience. The critical period hypothesis of Lenneberg (1967) holds that such interaction must occur before the time of puberty in order for normal primary language acquisition ever to take place. Puberty is claimed to be the critical time when speech functions are dominantly lateralized to the right cerebral hemisphere.

Earlier Penfield (Penfield and Roberts 1959) argued that, due to the growing loss of plasticity with increasing age to learn language by the direct method, second language teaching was best suited to young children. Likewise, Lenneberg discussed his hypothesis by extending it to apply to second language acquisition. Scovel (1969) strongly claimed that the completion of cerebral dominance caused the loss of the capacity of adults to fully acquire second languages, which their permanent foreign accents exemplify. After having re-examined Lenneberg's data, Krashen (1973) took the lateralization period to be much earlier, that is at the age of five. These issues have generated a discussion against the strong hypothesis and its implied consequences, because the fact is that adults learn and acquire foreign languages, and the foreign accent is not always so conspicous as the hypothesis suggests.

Lateralization is not a unitary phenomenon, so that its implications are not clear. Although we do not accept the critical period or lateralization in its strong version, there is no denying that the mother tongue is acquired during the time when cerebral maturation is developing. Therefore, the internalization of the native language is likely to be influenced differently from that of a foreign language whether it is learnt before puberty or not. It is not clear how two languages are internalized when they are acquired simultaneously from infancy on. The external language proficiency of a bilingual often seems to be equally good, but the struggle and interference between the two languages suggest that the linguistic expressive tools operate on a higher and more superficial level than propositional thinking. As far as I can see, the struggle does not affect the actual thinking process but the production of the propositions in suitable and correct expressions. In any case, the fluency and automaticity of knowledge and skills are guaranteed by an early bilingualism.

11.3. Interference in foreign language learning

Those who suggest that second language acquisition is based on prior language experience reason on the basis of the interference hypothesis. The interference hypothesis has been discussed particularly in connection with foreign language teaching. It has long traditions, dating back to Haugen (1953), Weinreich (1953) for bilingual speech communities or communities providing language contact, and to Fries (1945) and Lado (1957) for foreign language teaching. The amount and qualitity of interference can be and have been stated differently among researchers, varying from strong reliance on interlanguage hypotheses which are seen as a transitional phase in the acquisition process. In its strong version, the interference hypothesis might state that the learner acquires the second language through his native language so that he will substitute all L2 structures and items for L1 elements.

In the early days of linguistic contrastive analysis, the structural similarities and differences were compared between two languages. Also, this analysis was related to transfer theory by Lado (1957, 2), expressing it in terms of a tendency of individuals to transfer forms, meanings, and their distribution from their native language to the second language. According to Hammerly, such a tendency may manifest itself as three types of transfer: positive, negative, and zero. Positive transfer or facilitation occurs to the extent that two learning tasks are the same, but the outcome does not obtain if the learner does not know or is not informed of the identical structures in teaching. In the contrary case, the learner may tend to avoid identical structures in his effort to differentiate between the two languages. Negative transfer or interference occurs to the extent that two learning tasks are different but related. Zero transfer occurs when the two learning tasks are unrelated. (Hammerly 1982, 146-147.)

Interference can be seen as either interlingual when it is based on differences in categories, constructions, elements, rules, and meanings across languages, or intralingual when it takes the form of overgeneralizations which are based on second language irregularities, complexities, and asymmetry. Furthermore, interlingual interference can be preclusive or intrusive. Preclusive interference interferes with learning something that does not exist in the learner's native language. (Hammerly 1982, 147-148.) For example, the lack of articles in Finnish causes problems one way or another in learning a language with an article system. Intrusive interference refers to the native-language elements that are used in the second language erroneously. Although most people consider only the intrusive type as interference, I agree with Hammerly about the relevance of both types on the basis of my experience with teaching.

The early hypothesis of contrastive analysis has been criticized, and as a consequence, two clearly differentiated versions have emerged: contrastive analysis a priori, which is also called the predictive or strong version, and contrastive analysis a posteriori, which is called the explanatory or weak version (Schachter 1974). The former is more concerned with a structural analysis between two languages, whereas the latter focusses on analyzing the learner's errors that arise due to the similarities and differences between two languages. This interference is then measured on the basis of errors. Error analysis, however, faces many methodological problems. One of the fundamental difficulties is to categorize an error and to identify its source. Those who work within the interference hypothesis are likely to overgeneralize the types on the basis of surface observations. Also, it must be remembered that an error against a second-language rule that the learner does not know cannot be considered an intralingual error. If this has been observed in the studies on errors, it is not known, but Dulay and Burt's study (1974) has been criticized for mistakenly interpreting the errors as intralingual although they were clearly interlingual (Abbott 1980). Therefore, we must interpret outcomes and conclusions with caution and not rely on exact figures.

For example, varying percentages have been reported on the number of interlingual and intralingual errors. Sheen (1980) mentions that percentages as high as 70% of the lexical and grammatical errors in English made by French-Canadian children of six years of age functioning bilingually were due to their native language. At university level, the corresponding percentage was found to be 60. Perhaps estimates of about 50% for interlingual and 30% for intralingual errors are most commonly reported. These figures might apply to intermediate levels of proficiency. It has been noted that, among advanced students, interlingual errors play a smaller role. They have been found to constitute 36 percent of the errors by Grauberg (1971) and estimated at one third in the study by George (1972), cited by Hammerly. Several studies (B.P. Taylor 1975, Dommergues and Lane 1976, for example) show that interlingual errors gradually decrease and intralingual errors gradually increase from the beginning to the advanced level.

Interestingly, the errors persisting up to the near-bilingual level have been found to be overwhelmingly interlingual. This was found by B.D.W. Hocking (1973) of speakers of English as a second language, and Sheen (1980) confirmed this of French-English near-bilinguals whose interference from the native language was by far their most important source of errors, many of them being fossilized. Hammerly (1982, 153) interprets this trend as perfectly harmonious with transfer theory. In the beginning, the learner only knows his native language, on which he is forced to rely primarily. As he learns the second language, he comes to rely more and more on it, resulting in a decrease of interlingual errors and in an increase of intralingual errors. The fossilized interlingual errors are explained by Hammerly to be due to faulty or insufficient feedback, but I cannot accept this as a complete explanation, because there must be many more factors that are involved.

The above discussion has already given corroborative evidence of interference for our assumption in the preceding chapter. There is, however, one further difficulty in interpreting the interference hypothesis. A vast body of empirical studies has concentrated on the interference of the surface structures. For example, Taylor (1975) investigated syntactic overgeneralization and transfer phenomena in English. Syntax and morphology have often been the object of study, perhaps because they often embrace grammatically definable constructs which are easier to cope with. On the other hand, syntactical categories are difficult to distinguish from semantics, and therefore, many studies include somewhat arbitrary categorizations. By far the commonest errors are lexical, more than 50 percent in Grauber's study (1971), for example, but they are not easily categorized either. Besides, there is no guarantee that, in free production, the speaker has been able to produce exactly what he really meant. Since the receiver interprets it in his way, based on his background knowledge, the outcome may be in favour of the learner's correct expression as readily as in his disfavour.

Most of the research on interference assumes a strictly bilingual situation. But a multilingual setting where a foreign language is acquired over a background of two or more languages operates along different lines, following a paradigm characterized by the transferability of the function of the mother tongue to any one of the background languages. Based on empirical studies and classroom observations, Chumbow (1981) hypothesizes that in learning a foreign language one language functions in a special relation with the target language. The learner needs a firm stand or past linguistic experience in the form of an internalized linguistic system from which to tackle the foreign language. It can be the mother tongue that serves as an inferential basis in second languge acquisition. In learning a third, fourth, etc. language, the mother tongue may but does not always enjoy the special relation with the target language. The learners themselves appear to perceive such a language as a sort of mother tongue. Thus Anglophone Cameroonians learning French appear to perceive English, and not their first language, as their mother tongue in the learning experience.

Chumbow's hypothesis is very feasible and becomes more understandable if we think that English and French share the same cultural and conceptual background to a larger extent than either of them with the Cameroonian native languages. Since one second language has a dominant role in education, it naturally functions in a special relation to the target language. The situation is not so clear in foreign language teaching if none of the foreign languages gets a dominant role in the curriculum, in European circumstances for example. Therefore, the relatedness of the foreign languages and the knowledge that the learner has of the other foreign languages plays an important role in the choice of inferences, and the transferability of the mother tongue function is not so predictable.

This influence from other foreign languages complicates the interpretation of errors. It is unquestionable that their influence is involved in the errors, but not in a universally predictable way. Other foreign languages provide the learner with more knowledge and thus informative alternatives for processing the new foreign language, but also with possibilities of interference. Behaviourally, there may occcur a phenomenon which Hammerly (1982, 154) calls an "I'm-speaking-a-second-language" syndrome. In other words, the language learner is likely to draw primarily upon any previously learned second language, even if weak and unrelated to the new one, because he feels he must sound foreign and avoid his native language. This is obviously an observation based on practical experience. My observations would predict that the syndrome occurs only in interaction with foreigners. If the learner speaks the foreign language with those who share his native language, he is more likely to resort to the mother tongue, and possibly ask for translations for a particular word or phrase. Such situations arise in class, for example.

There are also claims, such as Felix's (1980a), that within the total range of errors occurring in second language morpho-syntactic development, negative transfer from L1 must be attributed a comparatively insignificant role. Structural similarities between L1 structures and ungrammatical L2 utterances do not automatically justify the assumption that interference is the cause of the error. Felix attempts to demonstrate that within the context of a learner's total second language development ungrammaticalities which superficially look like interference may originate from deeper regularities of the acquisition process.

In the light of the above discussion, I am inclined to consider the transfer hypothesis in connection with language errors to be too simplistic an account of the learning and acquisition process. B.P. Taylor (1975), for example, concludes his empirical study with the remark that the learner's cognitive characteristics and his resulting learning strategies must also be taken into account. He considers his findings consistent with a theory which regards second language acquisition as an actively creative process dependent upon a student's ability to assimilate and subsume new information into already existing cognitive structures. Roughly speaking, I can agree with Taylor, but my basic reservation concerns the concept of creative process. Rather, it is a constructive process because nothing new is created.

Although second language researchers have noted that certain situations are more likely to produce evidence for interference than others, they have so far neglected to determine which properties of the linguistic structures are crucially involved in the systematicity of L1 transfer. Wode (1981, 51), in taking a compromise view on the identity hypothesis which claims that acquisition strategies are identical for native and foreign languages, accepts the standpoint that man relies on the native language as an integral part of his natural ability to acquire a second language. However, he claims that the strategies have to be amended by such strategies that govern L1 transfer. He considers the main task of research is to specify the nature and the functioning of either type of strategy in terms of linguo-cognitive functioning. The concept of linguo-cognitive faculties is based on Wode's universalist approach and his hypothesis about language internal analyses, which are actually described as linguistic rules (p. 32ff).

Another research problem is to determine whether L1 transfer has anything to do with acquiring an L2, or whether it is merely a production strategy used to solve situations with the help of speech — perhaps comparable to other problem-solving strategies (Wode 1981, 51). On the whole, the interference hypothesis with its transfer implications is an inadequate and unsatisfactory construct for the research of foreign language acquisition, basically because it covers such a small area of the important factors involved in the learning and acquisition process of foreign languages. It remains to be shown if a specific system of devices is needed to account for foreign language learning. Assuming specific linguo-cognitive devices seems to me to be a variant solution of innate hypothesis, which tends to conceal our ignorance and inability to account for learning processes adequately.

12. Models of foreign language learning and acquisition

Many models of second language acquisition, learning, and use have been proposed in recent years. Most of them take into account only one or two aspects of the language acquisition and use processes, which suggests that a single model cannot perhaps explain all aspects. Behavioural, mental representations, processes, etc. seem to call for different models. Generally speaking, we can state that all different models and theories include ingredients that are very feasible, but the problem is that they do not cover the whole thing. The following discussion will briefly outline different approaches.

The linguistic system used by a learner in his attempted production of a target language is called an interlanguage by Selinker (1972). He suggests that there are five central processes or strategies in the latent psychological structure of humans. These processes are language transfer, transfer of training, strategies of second-language learning, strategies of second-language communication, and overgeneralization of target language material. These cognitive strategies can account for the utterances of students of a foreign language. It is obvious that such strategies occur in utterances, but the model is restricted in scope because it basically relies on error analysis. Focussing on the linguistic aspects leaves many important factors unobserved.

Schuman (1976) observed that there are certain similarities between second language learners' interlanguages and pidgins, and therefore, proposed a Pidginization Hypothesis of second language acquisition and learning. I do not think that the hypothesis is generally valid, because the simplifications that may occur in second language acquisition resemble pidginations but are most likely to occur for societal and psychological reasons, and not necessarily as evidence of the acquisition and learning models. One can hardly think that such a situation would arise in foreign language teaching, for instance.

Krashen (1978) proposed a Monitor Model of second language performance, according to which an adult can internalize rules of a target langugage via one or both of two separate systems: an implicit way, termed subconscious language acquisition, and an explicit way, conscious language learning. Language acquisition requires meaningful interaction in the target language, natural communication, in which speakers are not concerned with the form of their utterances but with the messages they are conveying and understanding. Acquirers need not be aware of the rules they possess, and may self-correct only on the basis of a "feel" for grammaticality. The fundamental claim of the Monitor Model is that conscious learning is available to the performer only as a Monitor. In general, our fluency in production is based on what we have picked up through active communication. Our conscious learning may be used to alter the acquired system, sometimes before and sometimes after the utterance is produced. These changes are made to improve accuracy.

Krashen (1980) argues that his Monitor Model gets support from the findings when second language performers concerned with communication appear to make errors (in the domain of grammatical morphemes) similar to child second language errors, reflecting the use of the acquired system. Furthermore, when adults are asked to write "carefully" or correct their own errors by going over their own work, they appeal primarily to the acquired system rather than to conscious rules. Krashen concludes that, in contrast to discrete-point language testing, second language performers do not use their conscious Monitor very much when they attempt to communicate their ideas. Krashen's observations may be partly true, but it does not justify him to conclude that the difference is due to learned and acquired rules. Rather, the explanation must be found in the deficient mastery of the language and lack of fluency.

Krashen's model has generated much discussion and has been criticized with justification. On the whole, the model gives too simple a picture of the acquistion process. The crucial difference between the two processes of acquisition and learning cannot be due to the consciousness of the event, as the model suggests. Rather, the difference concerns itself with automatization of the rules. The initial exposure cannot be so unconscious, and the total lack of awareness of any rules must be a mistaken conception. Besides, there is a vast body of evidence that accurate proficiency cannot be achieved without due conscious attention to certain regularities of the data. The many survival levels of the language among immigrants, for example, and the fossilizations that are almost eradicable are evidence of the negligence of conscious learning.

Bialystok (1978) proposes a model of second language learning. It outlines aspects of the input of information through various kinds of exposure to the language, the storage of that information for the language learner, and the responses that are produced as a function of the stored information. The operation of the model is explained in terms of learning processes and learning strategies. Despite its advantages, including the strategies of monitoring and inferencing among other things, the model is general and has weaknesses in terms of thinking in a foreign language. The inadequacy is mainly due to the fact that the theory has been developed on the basis of the existing literature on second language learning and acquisition, which limits its possibilities to account for second language learning.

Hammerly (1982, 205-216) proposes a Two-Cone Model of second language teaching and learning. It aims to describe the most important aspects of the process of second language learning resulting from formal teaching and leading to the development of a fairly high degree of linguistic, communicative, and cultural competence. The model gets its name from the representations of the native and the second language as cones. Within each cone, phonology is shown primarily at the apex, grammar (morphology and syntax) appears in most of the central area, and vocabulary and semantics are shown all along the periphery but mostly at the base of the cone. This order of second language subsystems corresponds to their logical order of emphasis in teaching and learning. The number of rules increases from phonology to vocabulary. The learning of vocabulary incorporates the largest number of elements, and is a learning task that continues indefinititely beyond the second language program.

Initially the two languages contact at their most superficial levels, i.e. phonetic, when the apices of the two cones touch each other. As the learning of the second language progresses, the second language cone can be represented as entering the native language cone and emerging gradually from it. The intent is to represent simultaneously both the learning of the second language and the overcoming of the interference from the native language. Hammerly is, however, aware that interference has not totally disappeared although the phonology area has come out of contact. Hammerly (1982, 208) admits that especially with the sound system, the rules and elements are frequently not fully mastered and are not completely free of native language interference, with the result that the learner's system contains fossilizations.

The teaching and learning of second language grammar can be similarly characterized as the second language emerging from contact with the native language. In addition to interlingual errors, there is a growing number of intralingual errors as the learner increases his knowledge of the second language and relies more and more on it. Interlingual and intralingual errors are made in regard to both new rules being learned and to incursions into linguistically unknown territory. With an increase of the knowledge of the second language, there is a corresponding increase in intralingual errors, whereas interlingual errors tend to decrease.

There is much that is interesting about the model, and from the practical point of view, it may offer a valid model. The strong emphasis on the inverted development of errors does not seem quite sound to me. The trend is clear but the intralingual errors are not easily isolated from interlingual errors, particularly if we think of the numerous inexactnesses that occur in the use of vocabulary and in the allocations of words. Despite their face value, they are most likely to originate from the native-language influence as it appears in propositional representation. In terms of thinking, it does not offer much because its limits are mainly set within linguistic domains.

There are many more attempts to outline theories but they do not seem to be more comprehensive or more adequate. The main reason is that theory development has been based on empirical data that is narrow in scope, and on the other hand, the phenomenon of foreign language learning and teaching is heterogeneous and complex in structure that a succcessful attempt will not be seen in the near future. The question is also related to the issue of whether it is important to keep the various modes of language learning separate. It is often claimed that foreign language teaching produces learning that is dissimilar to naturalistic learning. Various reasons have been provided to account for the fact that foreign language teaching does not normally result in fluency in communicative situations. The interesting thing among the many reasons given is that purely linguistic problems are considered of secondary importance for the success of the activity (Sajavaara 1983). This might be challenging to pedagogical research, but failures as such cannot be employed as support for the dissimilarity claim. Wode (1981) defends the claim by appealing to the evidence for L1 interference, which makes foreign language teaching not totally like naturalistic foreign language acquisition.

Without taking a standpoint as to how acquisition and tutored learning differ as to linguistic knowledge, the issue is treated in too narrow a perspective if research on acquisition does not go beyond purely linguistic knowledge. Sajavaara (1983), for example, argues for the inadequacy of the hierarchical linguistic descriptions of the processes that take place in the speaker and the hearer, because they do not take into account the fact that production and reception are creative processes. Rules of the speech community only partially cover the various negotiation processes created ad hoc in each individual communicative situation. Characterizing the learner's acitivies as creative seems an exaggeration to me, because he is not creating anything novel. Instead, I would define such strategies and processes constructive because they utilize the new and the old information in order to arrive at a solution. This is congruent with the construction of mental models on the basis of propositions.

Based on the theoretical development and empirical findings in the Finnish-English cross-language contrastive project, Sajavaraara claims that perception operates over stretches of speech longer than single elements and integrate the cues spread out in real time into a percept skeleton. In fluent speech perception, meaningful items are identified directly from detected cue information. In case of difficulty, a detailed categorization is resorted to as an auxiliary strategy. Likewise, speech production takes place in larger units. The opening of an utterance is usually cued by the previous utterance, and thus functions as a grammatical, semantic, and pragmatic constraint for the subsequent part. Fluent processing requires the synthetic 'Gestalt' mode. This supports the view that comprehension proceeds at a propositional and not at a phonetic level.

Structural contrasts between two languages can explain only part of the language learners' problems. Therefore, a non-native speaker's speech performance must be studied in the wider framework of communicative success in interactional situations. The results of the tests carried out by the Finnish-English Cross-Language Project seem to imply that Finns process English somewhat differently from native speakers of English. The tests consisted of various kinds of narration and reading tasks and concentrated on problems with pausing and rate of words. The differences can partly be explained by the structural differences between the languages, knowledge of English, and the conscious monitoring of the performance. (Lehtonen 1981.) The work with discourse features and fluency (Sajavaara and Lehtonen 1978) indicated a transfer effect from the mother tongue that extends beyond the grammatical structure. Also, the mother tongue effect can be distinguished between Swedish-speaking Finns and Finnish-speaking Finns. Swedish provides a more advantageous background than Finnish, because of its relatedness to English. (Ringbom 1979.)

The above examples already show that linguistic units are not adequate in investigating language learning. The reason why we have not found a more adequate theory of foreign language learning may lie in the research approach. If we content ourselves with merely linguistic units, no change of course in theory development is likely to take place. On the other hand, various sociological factors have been observed, and accordingly, second language learning theory has turned in that direction, but I cannot find it reasonable.

Since a foreign language speaker truly seldom achieves the same level of proficiency as an educated native speaker, he must content himself with the knowledge he has of the foreign language. In comprehending foreign-language speech, he cannot control the linguistic material that he hears or reads, but in production, his knowledge of the foreign-language linguistic expressions constrain the linguistic forms in which he can say his propositions. Part of the proficiency in a foreign language is to master such strategies that enable him to say his original proposition in a linguistic form that deviates from the form near the surface level in which the proposition had been produced by propositional thinking. Avoidance, paraphrase and transfer exemplify such strategies, which Palmberg (1979) investigated in the English productions of some Finns, Finland-Swedes and Swedes.

In Germany, the project at Wuppertal, grouped around Jürgen Meisel, centres on adult and child migrants' acquisition of German. In the analysis of linguistic structures, Jürgen Meisel has concentrated on the simplification issue. The migrants' second language is compared to other types of simplified speech. In his report (Meisel 1980), he argues that there exist different kinds of simplification in natural second language acquisition. Comparing lexical and syntactic features of English, German, French, and Finnish foreigner speech, he can show that they use largely the same means of simplification. Since these features are almost identical to those in other simplified varieties of each of these languages, he hypothesizes that simplification in L2 acquisition is the result of certain strategies used by the learner, and not the result of the learner's imitation of foreigner talk, as suggested by Bloomfield.

Meisel (1980) claims that at least two kinds of simplification can be distinguished: *restrictive* simplification facilitates the use of the acquired grammatical system and *elaborative* simplification prepares the next step on the learner's way towards the target variety of L2. In restriction simplification, verb inflections are, for example, simplified but not necessarily by using infinitives. Rather, some invariant form is chosen, by generalizing either a Standard form for all persons, for number and tense, or some interlanguage form which does not exist in the target language at all. Some people, but not all, may also use infinitives. The distinction enables us to distinguish L2 interlanguage from foreigner talk; the latter does not seem to contain instances of elaborative simplification.

Restrictive simplification is more likely to be used in early stages, but some learners never abandon it, thus using a basilectal variety. The distinction hypothesis divides second language learners into two groups, not adequately though, and predicts that at a certain point learners take different routes. Basilect speakers are likely to adhere to strategies of simplification which enable them to communicate efficiently with a minimal stock of linguistic means. As a result, the structures acquired in an early stage become fossilized. In addition, certain features develop which do not appear in later stages of language development. The language development of basilect speakers comes to a halt when successful communication is possible. The exact point depends on the needs of the individual speaker. Those foreigners who aim at integration or assimilation will elaborate their linguistic system.

I do not think learning strategies and communication strategies are so far away from each other, because one has to utilize certain strategies in order to survive in communication. That is also part of learning so that both strategies become interwoven. Learning is part of how human beings acquire, process and store information and how that knowledge can be retrieved when needed. If information is committed to memory by elaborating it with additional redundant information, then those elaborations can be expected to facilitate recall by providing retrieval paths and by permitting recall by inference and reconstruction (Anderson 1980, 194). What such systems of stored information are like and how such cognitive structures work in learning and remembering must be part of the theory development in terms of foreign language. Therefore, I believe that a new source of inspiration for research is psychological research where various theoretical constructs within cognitive structures and functioning have been developed. Some symptoms of research being directed in that direction are McLaughlin et al. (1983), who view second language learning from an information-processing perspective, and Carrell's (1984) investigation of a formal schema in comprehension as well as Tarone's (1981) communicative strategies and Faerch and Kasper's (1984) discussion of them from the psycholinguistic perspective. My present investigation into thinking in a foreign language is also an attempt in the direction of cognitive psychology. The future will show whether the steps taken have been successful and led to fruitful paths.

13. An empirical investigation with a cloze test

13.1. Purpose and problems of the empirical study

Looking back at the theoretical development of this paper, we may note that a lot of questions need empirical answers. Nevertheless, we must confine our scope of interest and focus on studying the empirical evidence for or against the main problem of our study. Therefore, I shall attempt to answer the following questions:

1. Does inferencing in a foreign language rely on mental models and propositional thinking?
2. Does the three stages of the theory of comprehension apply to understanding foreign-language discourse?
3. Does propositional thinking manifest influence from the mother tongue?

It would be natural to investigate people who have a near-native knowledge of the foreign language, but school education in the senior secondary classes also aims at an achievement of communicative proficiency in a foreign language. A nine-year-long programme of comprehensive and senior secondary education should result in a fluency of the foreign language, at least of the written form. Therefore, it is reasonable to expect pupils in their final stage to have achieved this level and to be capable of thinking in a foreign language in the sense we have discussed it previously. Although they have not gained full automaticity, their use of language should indicate symptoms of thinking in a foreign language.

Pupils' inferencing in English as a foreign language was investigated by analyzing their responses to a cloze test. Any text can be changed into a mutilated version, from which randomly chosen words are deleted, and the subjects are requested to fill in the blanks with appropriate words. Cloze is actually a technique of preparing a distorted text, which is given as a task to measure various psychological factors or subjects' knowledge of language. The purpose of this study is to test some of the hypotheses that were previously presented about people thinking in a foreign language.

Since there is really very little that can be concluded about the subjects' thinking on the basis of their responses to the blanks, my aim is to analyze the false answers in order to understand those processes that underlie various false insertions. I have not come across a single study that has focussed on an analysis of the errors made in a cloze test from such a perspective. My goal is not, however, the same as that of the conventional research approach of error analysis discussed previously. I shall not try to explain the causes of all the errors, even though a few examples will be discussed to study the mother-tongue influence. Before we can report on the empirical investigation, we shall outline a theoretical framework that might account for performance in the cloze test, and a rationale that can be found behind the errors.

13.2. A theoretical background of the cloze test

In the cloze technique, first developed by Taylor (1953), a test is prepared by systematically deleting every *n*th word from the chosen extract. Subjects are required to fill in the gaps with a contextually appropriate word. On what basis the subjects should be capable of performing the task has led to different theories of the cloze technique. Taylor himself suggested that cloze should be based upon the Gestalt theory of perception, i.e., that people tend to fill in gaps in their minds. This view can be criticized and even be rejected by appealing to the Gestalt theory. But it can also be defended if we take a broader and more modern interpretation of perception. Jonathan Anderson (1976), who criticized the Gestalt view derived the logic of the cloze test from the theory of communication. The receiver knows his language system, and on the basis of the grammatical and semantic cues he can fill in the gaps with the most probable equivalents.

The construct of redundancy has been borrowed from communication theory, which, again, was developed on the basis of information theory. It has been used as a theoretical concept to account for the knowledge the reader has available (Shannon and Weaver 1949). Partridge (1981) has analyzed the concept of redundancy and argues that information theoretic redundacy (ITR) is fundamentally a composite concept and has been continually misinterpreted. In addition, it differs from the usual meaning of redundancy employed in ordinary language. Thus, this informatic theoretic concept is not used quite appropriately in the communication theory.

A fundamental measure is that of entropy or information from a source. It is a measure of how much choice is involved when selecting successive symbols for a message from the alphabet of all possible symbols. This choice arises because not all of the possible sequences of alphabetical symbols may be messages due to constraints within languages which demarcate a class of grammatical sequences. The entropy of a source is at its maximum when a completely free choice from the total alphabet is possible, each different symbol occurring with equal probability. Rules which limit the possible symbols at one point in a message due to the occurrence of certain symbols elsewhere in the message entail a reduction in entropy for this source with respect to this language. Hence, we obtain a measure of the relative entropy of a source, which is its actual entropy due to language constraints, divided by the maximum entropy possible. Then information theoretic redundancy is defined as one minus the relative entropy. The existence of a language entails ITR within the sentences of that language.

A natural language contains much ITR. If it can be measured, and a value of 50 percent is obtained, it means that, in principle, such a text can be recoded utilizing the same alphabet, contain the same amount of information as the original and yet be 50 percent shorter. That is a re-encoded reduction. By true redundancy (TR) we mean redundancy in its usual sense, for which no documented history or formal definition can be given. Such characterizations as superfluosity and excessiveness can be accepted only on the condition that we agree that the fundamental purpose of communication is to convey meaning. One interpretation of TR is the maximum amount of structured deletion that is possible without loss of meaning. If a message is 50 percent redundant, 50 percent of the message can be deleted and yet the reduced message will carry the same amount of information. If partial redundancy (PR) is defined as redundancy when the number of possible choices is two or more, but less than the total alphabet size, then ITR = TR + PR. (Partridge 1981.)

It is not quite clear how true redundancy and partial redundancy should be divided. Within psychology, the distinction is usually made between distributional redundancy, which is due to an unequal average distribution of the basic alphabet within messages in the language, and sequential redundancy, which is due to constraints upon sequences of the basic symbols. Despite its use in psychology, redundancy is seen as a feature of the message. Even the idealized calculation of true redundancy does not seem to me to be a correct assumption, because it presupposes that a subject, in principle, can guess the original word correctly. This might be possible if the meanings of sentences were only dependent on the linguistic surface structure. As the whole preceding discussion of this paper has shown, it is an impossibility. Hence, the conceptual background of redundancy from the communication theory is not adequate for the rationale of a cloze test. The same applies to the psycholinguistic interpretation of redundancy on similar grounds. A psycholinguistic interpretation of the utilization of redundancy is that a person has acquired a grammar of expectancy, on the basis of which he can guess the missing parts of the message. These expectancies occur at various levels: phonetic, phonotactic, morphemic, lexical or stylistic levels, for example (Enkvist and Kohonen 1976, 9-11).

A vast body of research literature has come out since the early days of the cloze test. It has been used for a variety of purposes. It is recognized as a reliable and valid measure of reading comprehension and text readibility for native speakers of English. When applied to non-native speakers, it is regarded as a reliable and valid test of general second language proficiency. Research on the cloze test has touched upon various problems related to its administration, its technical characteristics, its scoring and its application to the measurement of reading fluency, language abilities and second language learning. Recently, questions have been directed to its construct validity. More specifically, research has examined the extent to which cloze deletions are capable of measuring language abilities beyond the knowledge of sentence-level grammatical structure. Despite considerable differences, studies on this question seem to have some consensus in that not all deletions in a given cloze passage measure exactly the same abilities (Bachman 1985).

Previous attempts to find an appropriate theory to account for performance in a cloze test have frequently concentrated on the surface level, and thus on the linguistic code. Since it is almost a truism to say that languages differ greatly at that level, there is no reason to believe that the cloze technique produces similar results in all languages, because the language structure determines how the passage will appear to the subjects after certain words have been deleted. Therefore, there is no basis even to imagine that a systematic or random deletion of words from the language structure of a given text should predict certain permanent abilities or a specific knowledge of linguistic rules across languages. Most studies have investigated the English language, either as a native language or as a second language. English is an excellent language for testing, because it is analytic in structure, so that the missing parts frequently become obvious, because the text is left with so many cues for making inferences. But a language like Finnish carries so much information in almost every word of a context that it becomes practically impossible to guess what the original word was. A deleted word may drop all the information related to the case, possessive suffix, other inflectional tokens, tense, person, etc. Since the word order is fairly free, a lot of syntactic cues are lost with the morphological information as well. If the subject can now construct a coherent story, there is no guarantee that it is near the original, not to speak of the exact original, and it can still be a sensible and cohesive text. The ability to make it so cannot only be due to the subject's linguistic knowledge.

In contrast to previous suggestions about the theory behind cloze testing, I cannot accept the view that people operate at merely the surface level, since it ultimately concerns understanding a discourse, even though in a mutilated form. When a subject is given a cloze test, it is like a problem-solving task and presupposes thinking. Therefore, I propose that the rationale behind cloze performance should be derived from the theory of how a mental model is constructed through the three stages of language comprehension. From that perspective, a subject attempts to construct a single model on the basis of the linguistic material that is visible. The gaps are of secondary importance in this phase. Just as linguistic expressions are generally ambiguous and vague, the deletion of certain words adds to the ambiguousness and vagueness of the discourse. If the subject cannot construct a single model, he is likely to resort to alternative models by experimenting with alternative insertions in order to test his hypothesis of a single model. Once he has found a solution, it is easy to fill in the gaps with the linguistically correct forms.

As we have noted in the preceding discussion of the theory, the construction of a mental model is optional in understanding. Thus, it is quite possible that a subject stays at the propositional level and contents himself with the meaning of a proposition, instead of understanding its significance in the discourse. This might explain the observations and claims that the cloze test only measures comprehension of the surrounding context, and not of the whole discourse. In cases where the subject only constructs propositional meaning, he does it in order to understand the contents of the proposition and not to solve the problem of gaps in the linguistic code. I think the linguistic code must be of secondary importance with regard to understanding the subject matter.

As the mental models do not encode linguistic expressions, the subject must also find appropriate linguistic tools with which to express the propositions. He must then be attentive to the linguistic surface level. If he is not careful enough, he may make a mistake or an error because he does not know or inadequately knows the morphological, syntactic, or semantic constraints that a given context sets on words that are possible to fill in. This is particularly so with foreign language learners who do not master the language completely. Lack of attention may also cause erroneous suggestions in terms of the linguistic form, even though they are semantically correct. On the whole, we may assume that proficiency in the particular language enables the person to complete the gaps with appropriate words in the correct form.

It is often claimed that a subject's correct responses in the cloze test indicate how well he has understood the discourse. This view may, however, be questioned. The above discussion clearly shows that if the person's knowledge of the linguistic code is deficient, he is not able to express himself adequately with his insertions either. Foreign language learners are particularly dependent on their language proficiency. As a matter of fact, there is no way of knowing how much of the text they have understood. The correct solutions naturally indicate understanding, but we can say nothing of the empty and mistakenly completed blanks if they are not analyzed. Therefore, a cloze test cannot be regarded merely as a test of understanding discourse; rather, it measures a kind of communicative proficiency in a foreign language.

In taking a cloze test, I believe, the subject is motivated to perform the task as well as possible. He attempts to understand the discourse. Nevertheless, I admit that pupils may have less serious attitudes to their performance, with the consequence that they may complete certain blanks without thinking of the propositional content of the sentence. In particular, some easy and obvious prepositions or articles may encourage pupils to behave in that way. I do not think we can fully get rid of such an attitude in any intellectual test performance. On the other hand, if a few functional words correctly inserted do not measure the comprehension of the discourse, strictly speaking, such items can be psychologically rewarding and encouraging for poor foreign language learners.

To what extent certain personal traits are involved in taking a cloze test will have to be shown by future research. If a cloze test presupposes inferencing and a kind of hypothesis testing, abilities and other cognitive factors are likely to produce inter- and intra-individual variance and thus error variance to test measurements. For instance, the psychological literature describes the cognitive style construct of field dependence-independence as a cognitive factor that affects hypothesis testing, inferencing, and restructuring behaviour on various problem-solving tasks (Goodenough 1976, Witkin et al. 1977). Stansfield and Hansen (1983) administered the Group Embedded Figures Test of field dependence-independence along with several measures of linguistic, communicative, and integrative competence to 250 college students enrolled in a first semester Spanish course. The results showed student field independence to be related consistently in a positive, albeit modest, fashion to second language test performance. A correlation of .43 was found between student field independence and cloze test performance. Since the relationship was less marked on other measures such as final course grade, the investigators concluded that a cognitive style bias might be operating in conjunction with cloze test performance.

In the investigations which have included other measures on foreign language proficiency in addition to a cloze test, researchers have repeatedly noted a substantial amount of variance that is not explained by the other language tests. Therefore, it has been suggested that taking a cloze test also involves other factors than mere language skills. Weaver and Kingston (1963), Oller and Conrad (1971) and Oller (1973) exemplify such investigations. Hanania and Shikhani (1986) found that there was a substantial residual correlation between cloze and tests in writing among a large group of students applying for admission to the American University of Beirut. The authors suggested that these tests may measure in common some aspects of language ability beyond those that they share with the University's English test, a standardized ESL test.

13.3. Rationale behind errors

In discussing certain aspects of Piaget's theories, J. Smedslund (1977) criticizes the circular relation between logicality and understanding, each one presupposing the other. It manifests itself in the decision of whether a child is behaving logically or not. The problem arises when we do not know whether the child has correctly understood a given term or instruction. Understanding the instructions is checked by agreement or disagreement with respect to what is equivalent to, implied by, contradicted by or irrelevant to the message. Logicality must be presupposed in such respects. So the researcher is compelled to choose which one to take for granted and which one to study. This observation led Smedslund to the conclusion that people must always be seen as logical (rational) given their own premises, and hence, behaviour can, in principle, be understood. This applies to children, foreigners and psychotics. Thus, the person's understanding of given situations becomes a matter for empirical study. It is always possible and intuitively plausible to presuppose logicality, whereas it is clearly absurd always to presuppose understanding. Smedslund's conclusion seems to be in harmony with the Johnson-Lairdian reasoning against a mental logic and with his theory of comprehension through mental models, even though it is not expressed in those terms. By accepting this conclusion, we may justify the view that pupils' errors must not be seen as inconsistencies within the logical behaviour of pupils, but as inconsistencies due to deficient understanding of the linguistic code.

In his essay, Brian Lewis (1981) discusses the problem of error from a general perspective, and considers it asymmetric to truth. He points out the wrong assumption that the attribution of error always requires reference to some criterion of correctness. Rules and laws are obvious cases of that type, but matters of taste, preference, value, ideology and human conflict are problem areas for which it appears impossible to devise universally acceptable criteria of correctness. Lewis suggests a solution by showing that there exist alternative signals of error which are not based on the difference signal of the strict scientist, but which nevertheless are reliable indicators of the presence of error. "They include signals to the effect that one is being led into "ad-hoc-ery" in one's thinking, or into the construction of some spectrum of valuations for trying to resolve points of conflict" (Lewis 1981). Even such phenomena as feeling hurried or confused or depressed, etc., exemplify sure signs that an error has been made, although they do not tell us what the error is or where, precisely, it resides. These signals do not necessarily relate the errors to any standards of correctness, but provide us with evidence of possible misdirection in our own thinking and acting.

By showing that there are alternative signals of error, Lewis (1981) may construe error as a form of self-limitation, instead of construing it as a departure from some standard of correctness. Thus he does not attribute error on the basis of the subject matter, but of the mental state that the doer experiences, makes error into a sort of mental blindness. From the psychological point of view, Lewis regards the notion of error as having its origin in the experience of failure. He thinks that error as a self-limitation is not something that we have to pressurise people into getting rid of, but rather, that is something that they will naturally want to get rid of.

Lewis's elucidation of the concept of error is fascinating and intuitively plausible. It opens up further theoretical developments, but must also be considered critically. However, we cannot digress from the main theme any further. It may suffice as reasons for the assumption that people tend to avoid errors, and hence we may conclude that they attempt to complete cloze blanks rationally. Therefore, we are also allowed to try to make inferences of their thinking on the basis of their errors. Many errors can, of course, be viewed from the perspective of the correct linguistic rules, but there are cases where rules are based on people's arbitrary conventions rather than on some strict linguistic system.

13.4. Methods

To find evidence for the hypothesis that readers operate through mental models and propositional thinking in comprehending written texts, the wrong answers given in a cloze test were examined thoroughly. The erroneous responses were interpreted in terms of correct mental models of the discourse and in terms of relevant propositions in the given context. My interest was in the processes of understanding a foreign-language discourse, that is, in the inferences that pupils made in completing the cloze test blanks. We must, however, content ourselves with the products of the processes and, on that basis, attempt to make inferences and conclusions about the underlying operations of pupils.

13.4.1. Instrumentation

The extract for the cloze test was taken from the structural exercises by Ona Low (1979, 35-36). It was not employed in its original exercise form with the gaps, but the text was first completed. From the text of about 250 words it was possible to make about 50 gaps if every fifth word was mechanically omitted. The lot for the starting point was drawn out of five, and it fell on the fourth word. From then onwards, every fifth word was deleted, and a total of 47 items was obtained (Appendix 1). A couple of times this mechanical rule was broken to avoid selecting too easy or too difficult a word. Some researchers may criticize this, because it is in contrast with the custom of a strictly systematic or a random selection. It was, however, considered more important to get a good test. Besides, in the light of my theoretical argument, it is quite defensible, because the surface structure does not occur so regularly that some deep processes would always be involved proportionally. Prior to the data gathering, the cloze version was pretested in a senior secondary school (N = 67).

13.4.2. Subjects

The population of the empirical investigation was the pupils of the third form in Finnish senior secondary schools. During the school year they were to take the matriculation examination and leave school in spring. They had studied English as a foreign language for almost nine years. A detailed sampling technique and the sampling of pupils is described in my previous study (Hellgren 1982, 102-108). The pupils' mother tongue was Finnish, apart from 20 students from a Swedish-speaking school. In fact, four of them had Finnish as their mother tongue, and the rest also mastered Finnish as well as Swedish, because the school is situated in the middle of the Finnish-speaking region. In other words, the pupils were so bilingual and so few in number that no marked difference in favour of their language was to be expected from the results. The sample of 498 pupils, consisting of 208 boys and 290 girls, came from ten different schools from all over the country and can be considered representative, and therefore generalizable to the population.

13.4.3. Procedure

The cloze test was sent to the schools at the beginning of September 1980. The teachers were allowed to give the test at an appropriate time. A

45-minute lesson was reserved for it, although 30 minutes was considered enough on the basis of previous experience. The teachers sent the answer sheets to the investigator who scored them. All syntactically and semantically suitable alternatives were accepted as correct, and awarded with one point. In other words, a so-called contextual method of scoring was followed. A marking list was kept of the alternatives given by different pupils, and the scores given for them, to co-ordinate equal points for similar responses. Attention was paid to the consistency of scoring. In the original experiment, no other data was gathered from the cloze test.

For this study, all the errors made in each item were listed on a separate sheet marked with the subject's number. This allowed me to get an overall picture of the types and distribution of errors. They were then coded along the variables of correct mental models and propositions. That is, they were interpreted in terms of whether they were correct with regard to the original mental model or propositionally feasible in the sense of semantically plausible insertions, despite possible lexical errors. No heed was thus taken of linguistic errors or mistakes in interpretation. Propositionally feasible suggestions might contradict the original meaning slightly, but be quite rational and relevant in terms of the subject matter.

A third variable was formed on the basis of those responses that indicated morphological, syntactical or lexical errors. The type varied somewhat from item to item, due to its context. The idea was to separate cases where a syntactically wrong insertion had additionally erroneous aspects. That is how double errors were marked off. A fourth variable of incomprehensible responses consisted of those errors that could not be interpreted as plausible with certainty, in terms of the context. It is important to note that they were not nonsensical suggestions but only inconsistent with the given context. The pupil most often had a definite idea of what he wanted to say.

After a decision at each error about whether it was to be included in the category of the variable or not, it was marked either as one or zero, respectively. This list was then utilized in coding the erroneous responses for each pupil in the total matrix of observations. Each item was coded simultaneously over all four variables and over all subjects to guarantee consistent scoring. Appendix 2 reports some of the most typical responses over items. Frequencies of the different types of errors might be reported systematically but they have lost their variances because they are not linked to the individual subjects. Some distributions will be utilized to show the influence from the mother tongue.

As for the reliability of the cloze test, it was estimated by Cronbach's alpha coefficient, which indicates internal consistency over the test items. The index was .85, and the standard error of measurement was 2.8.

Although the reliability index obtained can be considered good, as is often done, the question arises as to why it is not even higher, particularly, in the present study which measured language proficiency of varying degree with such a large sample. As the only explanation I can offer the assumption that cloze items measure mutually inconsistent aspects of performance to some extent.

The variables that were formed on the basis of errors did not constitute tests of similar type as the cloze, because there was a considerably restricted range of variation, due to the drop of most good performers who naturally made fewer errors and could not appear on the variables of errors adequately. Since the cloze items measured slightly different aspects of language in different items, the test could not be split into half randomly or systematically. Dividing the subjects into two groups and correlating their performances was not reasonable because the strict measures of being consistent in scoring actually indicated what such an action would have produced. Despite the restriction of range, an estimate of consistency was computed for the variable of mental models. The correlation coefficient was .33. It was also computed for the variable of propositions, but it was performed on a version that also included mental models. The obtained index was .61. To compute an estimate for propositions alone was impracticable because of the coding technique. The variable of propositions that is discussed in the later reporting is a sum variable, and exclusive of the variable of mental models. As a sum variable, it does not, however, lend itself to reliability estimates.

When we consider the reliability of the variables from the perspective of the scorer's persistence, it may be reported that, in practice, items were scored twice. The first time was concerned with the classification of errors, and the second time with scoring them on the computer matrix. Very few alterations were made, which indicates the investigator's persistent interpretation. No index was considered worth computing. Another problem is whether other scorers would have come to similar coding decisions. Due to the theoretical complexity behind the scoring, it was found too troublesome to train many scorers. Whatever index would have been obtained would not guarantee the reliability of the research, because one single empirical study does not give a final answer to a research question. Therefore, Lewis's rationale behind errors elucidates the standpoint taken in this study. It would be unwise to make conscious errors in scoring, because the investigator would face problems later. Some lapses cannot be prevented by reliability estimates. Instead, the scientific method presupposes further empirical investigation, and thus its principle of self-correctness will give such certainty to the results of the study that is usually believed to exist by reporting routinely computed reliability indexes.

13.4.4. Analysis of data and results

Scores of the test items are directly interpretable because they were coded dichotomically from one to zero. Categorization of the errors produced different test variables across all items. Correct responses to the cloze blanks naturally indicate that the pupils have understood the discourse. This means that they have comprehended the proposition and constructed the underlying mental model. Table 1 reports the main results of the categorization into variables according to the different types of representation, double errors and incomprehensible replacements.

Table 1. Main results of the cloze test and the different types of representation, measured as sum variables over the errors in the cloze test. N=498 (208 boys and 290 girls).

		Cumul.		Cumul.		Correlations			
Variables	%	%	$\bar{X}$	$\bar{X}$	s	2.	3.	4.	5.
1.Cloze	53.3		25.1		7.2	-.33	-.57	-.58	-.61
2.Models	13.7	67.0	6.4	31.5	2.6		.21	.65	.11
3.Propositions	16.9	83.9	8.0	39.4	3.3			.66	.48
4.Errors	15.9		7.5		3.5				.38
5.Incomprehensible	6.0		2.8		2.8				

Slightly more than half the items were correctly answered on average. An analysis of errors interpreted in terms of correct mental models resulted in an increase of the mean by 6.1 correct responses, which is 13.7 percent of the total number of items. Propositionally feasible suggestions increased the mean by 8 points or by 16.9 percent of the total. The category of propositional representation was separated from correct mental models because a propositionally feasible response need not be correct in terms of the mental models underlying the discourse intended in the original version of the text. A correct mental model is, of course, propositionally correct as well. Therefore the category of propositions forms an exclusive class from that of mental models.

When correct mental models are taken into account, pupils have understood 67 percent of the discourse, as measured of the total number of cloze items. This is a statistically significant increase in comparison with 53.3 percent. Propositionally feasible suggestions also make statistically significant contributions to the amount of understanding of the text version, forming a percentage of 83.9 of the total cloze items. Only six percent of the responses fell in the category of incomprehensible suggestions. This does not, however, mean that they were random fillings-in, because most of them were sensible but not possible in the context. Ten percent of the gaps were left blank (see Appendix 3).

Correlations among variables were computed but one must interpret them with caution because the measurements were not fully independent. Although errors occur abundantly across almost all items, their number is limited at the individual level if a person has many correct responses. Thus variances are restricted among successful pupils in particular. The negative correlations of variables to the cloze test are an outcome of this, indicating that those who scored high on the cloze test responded with fewer feasible propositions, and made fewer double errors and incomprehensible suggestions. There is a fairly weak inverse relation between cloze and models, and an even weaker but positive relation between models and propositions. A variable of sex was correlated with all the test variables, but it indicated a zero relation with any of them.

Since correlations only tell us about a general trend of the relationship between variables leaving out detailed information about possible differences in variances at various levels of performance, the subjects were divided into three groups of quartiles on the basis of the cloze test, the lowest quartile from score 19 and the interquartiles from score 30 downwards, so that the highest quartile scored 31 or more. A direct comparison between the variables could not be made because correct responses and errors were interrelated. Therefore, the subject's cloze scores served as a basis for sum variables, consisting of the correct responses and added to correct suggestions in terms of models, and in terms of models and propositions. The solution enables us to view comprehension from the perspective of the whole text. Table 2 displays the descriptive statistics of the analysis.

Table 2. Means, standard deviations and percentages of the sum scores among the quartiles over the different types of representation.

Types of representation	Quartiles									Total (N=498)		
	Lowest (n=114)			Interq.(n=269)			Highest (n=115)					
	%	$\bar{X}$	s	%	$\bar{X}$	s	%	$\bar{X}$	s	%	$\bar{X}$	s
Cloze	33.4	15.7	3.3	53.2	25.0	3.2	73.4	34.5	3.0	53.4	25.1	7.2
Mental models	48.3	22.7	4.9	67.9	31.9	3.5	83.4	39.2	2.9	67.0	31.5	6.8
Propositions	70.4	33.1	5.8	85.1	40.0	4.1	94.7	44.5	2.3	83.8	39.4	5.8

Statistical significance of differences between groups was tested with an F test and pairwise t tests. Heterogeneous variances were also taken into account. All differences were statistically significant over all sum variables between the different groups, and, within groups between the different types of representation. An increase of 13.7 percent of scores by the variable of mental models was not evenly scattered over the different groups. The lowest quartile and interquartiles contributed almost 15 percent to the increase in comparison with 10 percent of the highest quartile (Table 3). The acceptance of propositionally feasible suggestions increased the scores of all the groups by 17 percent, but the interquartiles only showed this increase, whereas the lowest quartile collected 22 percent and the highest quartile 11 percent more.

Table 3. Increment of means in percentage over the types of representation in the different quartiles.

	Quartiles			Total
	Lowest	Interq.	Highest	
From Cloze to	%	%	%	%
Mental models	14.9	14.7	10.0	13.7
Propositions	22.1	17.2	11.3	16.9

The differences between the types of representation is also reflected in the means of the groups. The means of the groups grew evenly at about 20 percent from the lowest to the highest quartile in the cloze test (Table 4). On the sum variable of mental models, the difference remained almost the same between the lowest quartile and interquartiles, whereas it diminished somewhat between the interquartiles and the highest quartile. On the sum variable of propositions, differences decreased further. The lowest quartile scored 14.7 percent below the interquartiles, whereas the highest quartile was barely 10 percent better than the interquartiles. The original difference between the means of the highest and the lowest quartile in the cloze test was 40 percent, but decreased to 35.1 percent on the sum variable of mental models, and to 24.2 percent on that of propositions.

Table 4. Differences of means in percentage between the quartiles.

	Quartiles		
From lowest to highest	Low-Interq.	Interq.-High	Low-High
	%	%	%
Cloze	19.8	20.2	40.0
Mental models	19.6	15.5	35.1
Propositions	14.7	9.6	24.2

The fairly equal standard deviations of the groups in the cloze test became differentiated when the scores of mental models and propositions were added to the cloze test scores. The dispersion in the lowest quartile grew from 3.3. through 4.9 to 5.8, whereas the interquartiles showed a smaller increase. Thus these groups, and particularly the lowest quartile, became more heterogeneous. The highest quartile, again, became more homogeneous because their scores were scattered less and less.

The variables of mental models and propositions were built on the errors and mistakes made in the responses. However, a separate variable of errors was formed to distinguish those that were related to the form of the response. The category was heterogeneous and meant slightly different types of errors in different items. Basically, a response was coded for this category too if it included two erroneous aspects. The most typical errors were made against the correct form or the wrong lexical meaning of the word. Table 5 gives some information of this variable and that of incomprehensible responses among the quartiles.

Table 5. Means and standard deviations of morphological, syntactical or lexical errors and incomprehensible responses in the quartiles.

	Quartiles									Total (N=498)		
	Lowest (n=114)			Interq.(n=269)			Highest (n=115)					
	%	$\bar{x}$	s	%	$\bar{x}$	s	%	$\bar{x}$	s	%	$\bar{x}$	s
Errors	21.5	10.1	3.3	16.2	7.6	3.0	9.4	4.4	2.1	16.0	7.5	3.5
Incomprehensible	12.1	5.7	3.4	5.1	2.4	2.0	2.1	1.0	1.1	6.0	2.8	2.8

The quartiles differ from each other on both variables. Typically, the lowest quartile made the most errors and the most incomprehensible responses. On the other hand, the number of incomprehensible replacements is relatively low if it is considered to be an indication of no comprehension of the total text. Only 12 percent of the responses were incomprehensible in the lowest quartile. The number of gaps left blank must be added to show the total incomprehension of the text. The overall figure is 10 percent.

The different variables were examined as tests and attempts were made to factorize the items. The idea was to find some factors on the basis of which the items on the variables of models and propositions could be investigated. Factorization of the cloze test into four to six structures was attempted by the principle axes model, and the most interpretable was a four-factor solution into the varimax criterion. The percentage of the variances explained by the factors was 17 (see Appendix 4). It was considered too low for further analyses. A similar attempt was made to factorize the variable of mental models with an outcome of six factors and an explanation percentage of ten. Therefore, further analyses on the correlational basis were totally abandoned.

Despite the small percentage of the variance explained by the factors, the highest loadings (above .30) on them were utilized to form sum variables of items in order to investigate possible differences between common factors across the different types of representation. The first factor was divided into two variables and the second factor was left out because of the low number of errors in the items that were loaded on it. Accordingly, the variables can be described as follows:

Ia. syntactically and semantically constrained responses, producing cohesion in the sense that the linguistic forms are contextually appropriate (items 13, 16, 18, 22, 36);
Ib. syntactically constrained but lexically free content-words, relying on plausibility of the discourse (items 12, 24, 38, 39, 42);
III. meaning goes beyond the phrasal expression indicating coherence of the discourse (items 8, 9, 10, 20, 34, 42);
IV. grammatical surface structure (items 1, 2, 19, 23, 29, 33, 44, 47).

Appendix 5 reports the means and standard deviations of the sum variables, built on the basis of factors, among the different quartiles across the different types of representation. Although the differences between the quartiles were preserved consistently over the different types of representation, no statistically significant differences were found between the sum variables as factors. A ranking order of the means in terms of easiness remained the same over the representations, apart from the exchange of place between Ib and III, that is, IV, Ia, Ib, III from easiest to difficult. A natural explanation might be suggested but the interpretation is too risky because there is no guarantee of real difference among the factors. Another difficulty is that factor IV included more items than the others.

Some of the errors were examined more thoroughly in terms of the mother-tongue influence (see Appendix 6). They were clear examples and undeniably assessable as such. In the sentence "she said that I need not take her ...", the use of 'would' instead of 'need' is a typical Finnish usage of a conditional form in a corresponding situation. Almost the same applies to 'could'. The use of 'with' in item 14 indicates 'taking along' in Finnish. Since the Finnish language might tolerate 'give' without a direct object in colloquial language in the context of item 16, suggestions like 'week', 'day', month', and 'little' become understandable. Although a personal object is expected in the English phrase 'it took me several minutes to locate...', it is not necessary in Finnish. Therefore, pupils were eager to fill in 'for' to express a duration of time in item 18. The use of 'queue' or 'queues' pro 'rows of beds' in item 24 shows a different prototype of meaning in the two languages. "I felt very depressed' in item 25 activated pupils to suggest 'myself' as a replacement of 'very' because in Finnish the reflexive idea is not included in the sense of the word. 'Lying'or 'staying' are typically Finnish expressions in a hospital situation, which explains that pupils did not notice there was no preposition of location expressed in item 20. The expression 'put aside' in item 33 has a Finnish equivalent of 'off'. The prepositions 'of' and 'about' in item 35 instead of 'for' in thanking someone for something are direct translations from Finnish to express the corresponding case.

13.5. Discussion

It may be assumed that correct responses to the cloze blanks indicate that a person has constructed a relevant mental model of the proposition expressed in the sentence. When the false insertions were interpreted in terms of correct mental models the amount of the comprehension of the discourse was increased nearly by 14 percent. This shows that pupils had really understood more of the original text than the correct responses indicated. A slightly greater increment in the amount of comprehension was observed when propositionally feasible replacements were taken into account. Strictly speaking, these responses could not be considered fully harmonious with the original version because of the linguistic restrictions of the context but their meanings were congruent with the propositional contents of the sentence.

Since the text was mutilated and pupils were able to understand more than their correct replacements suggested, we may conclude that reasoning could not be based on linguistic representation alone. In other words, the meaning and significance of the discourse goes beyond the linguistic symbols. This is the more remarkable, because the language was foreign to pupils and their thinking could not only be based on the language exposed to them. Also, incorrect responses in terms of the linguistic context suggest that they did not master the language completely, even though they could produce semantically comprehensible insertions. Consequently, this empirical evidence supports the theory of different representations in the form of mental models and propositions.

The average 67 percent of the correct mental models over the items can be considered an index of the total comprehension of the discourse. The fact that comprehension was increased up to 84 percent when propositionally feasible suggestions were counted can partly be explained by the ambiguousness and vagueness of the language, which semantically allowed itself to be interpreted slightly differently from the original discourse. That is not, however, all due to the inherent part of the English language, because native speakers stick to certain conventional interpretations of the linguistic symbols, and thus the range of variability is more restricted to them than to those who speak it as a foreign language. In this study it was not possible to distinguish the different sources of influence. Besides, it seems very difficult to determine a source of error even somewhat objectively in every case.

Whichever criterion we consider relevant, mental models or propositionally feasible responses, the index of comprehension can intuitively be regarded as plausible because the text was fairly easy for an advanced level. The intuitiveness is based on the experience that the writer has of pupils' foreign language knowledge at this level. If it had been given as a complete text, most of the pupils would have understood it without much difficulty. Therefore, the small amount of incomprehensible suggestions (6 percent) seems understandable. Nothing certain can be said of the ten percent of the gaps left empty. Partly they may have appeared as difficult items because pupils did not discover what might have been left out or they could not find a suitable linguistic expression for the blank. On the whole, empty gaps occurred in abundance in the answer sheets of poor performers, who perhaps found this type of test difficult and frustrating and gave up trying.

The division of the pupils into quartiles revealed that both the lowest quartile and the interquartiles scored about 15 percent higher when correct mental models were taken into account. The corresponding increase for the highest quartile was only 10 percent. Thus the originally equal distances of the highest quartile and the lowest quartile from the interquartiles in the cloze test was reduced by five percent for the highest quartile. A natural explanation might be that the highest quartile made fewer errors, thus causing a restriction of range. This does not appear very likely to me, and definitely not the only alternative, because the number of feasible propositions would have allowed a larger proportion in favour of mental models. Instead, I would propose that the cloze test as such provided even good performers with a few items that they could not solve relevantly in terms of the original discourse. In other words, a kind of ceiling was reached at the level of about 83 percent comprehension. We must remember that the deletion of words may involve such important information that cannot be inferred from what remains because the text is only partially redundant.

The propositionally feasible responses gave significant increases to the scores in all the quartiles. Compared with correct mental models, they yielded a propositionally larger increase of scores to the lowest quartile, and also to the interquartiles, even though a smaller amount, whereas the difference was not significant for the highest quartile. This might be explained by the restriction of range, but also, as above, by the uncertainty of the correct states of affairs. After all, pupils cannot master the foreign language like natives so that a full score would be a rarity. The reason why the lowest quartile and even the interquartiles to some extent scored relatively larger proportions in terms of propositions may be that they were less exact with the original discourse due to their deficient language knowledge.

In reporting the results, it was mentioned that the correlations between the different variables must be interpreted with some caution. However, the significant negative correlations between the cloze test and the variables of propositions, double errors and incomprehensible replacements suggest that there was some consistency between the measurements of the cloze and the errors, thus also indicating a degree of reliability. Instead, one is struck by a fairly weak relationship between the variables of mental models and the cloze test. This might be explained by the restriction of range among successful pupils, but the explanation is not sound, because the correlations were based on the sum variables. Rather, we might assume that there really occurred some inconsistencies in thinking, not directly linked with foreign language proficiency. In other words, why should we hypothesize that low or average proficiency in a foreign language is always evidence of weak reasoning or thinking?

A remarkable thing about the results is that even the lowest quartile reached almost an average level of 50 percent of total comprehension when mental models were included in the scores. Although the differences were preserved among the groups between the different types of representation, the outcome indicates that reasoning was made along correct lines of the discourse despite their deficient knowledge of the foreign language. This would not have been possible if not something beyond the linguistic knowledge was available to pupils in order for them to make inferences about the foreign-language discourse. Therefore, it is reasonable and justified to assume mental models and propositional representation as being separate from linguistic representation.

What is more, the stages of comprehension suggested by Johnson-Laird seem to be in congruence with the empirical results obtained in this study because the optional level of mental models is more difficult to reach than the level of propositions. In learning English, pupils appear to be capable of reasoning at the level of propositions before they can construct appropriate mental models of the discourse. This can be explained by the fact that the ambiguousness and vagueness of the semantic meaning of words allows pupils to understand propositions in broad lines on a less accurate basis than what mental models presuppose. Therefore, approximate comprehension is in most cases adequate to understand the main ideas in a given discourse. A more exact knowledge of the language meaning is required for comprehension of the significance of the text.

The examples of mother-tongue influence were chosen with the criterion that they were undeniable instances of it. They were to give some evidence for the claim, but no systematic analysis was made of all the errors, because determining a source of error without arbitrariness can be questioned at least in this type of study. The percentages reported for comparison, in proportion to all errors made in an item, do not give a very clear picture of the mother-tongue influence, due to the lack of systematicity. However, the number of the types originating from the native language were frequent in the respective items, which shows that thinking was influenced by the mother-tongue format, particularly because they occurred in all quartiles. Among certain errors it was possible to notice that the lexical meaning of the wrong word followed the prototype of the native language. It showed that pupils had not internalized a specified or modified version of meaning for the foreign language.

On the whole, errors were frequent but tended to concentrate on a few types per item, indicating that pupils seemed to be thinking mutually rather similarly in taking the cloze test. In items which allowed a lexically freer choice the number of suggestions was also more varied. Despite the many errors, pupils attempted to respond consistenly so that their errors could not be considered random replacements of whatever word occurred to them at the moment. If this had not been the case, an investigation of errors would have been carried out on a feeble basis for drawing any conclusions about thinking.

The use of a cloze test to measure thinking in a foreign language is of course limited, and it cannot give any final answer, just as no other empirical measurement can. Despite its restrictions, there is no reason to underestimate it as an instrument, particularly, because it was utilised differently from the common practice in empirical studies. The most serious criticism of it is that the processes of thinking were postulated on the basis of products on the cloze test, and the processes themselves could not be separated in a more detailed way. Future research must employ other and more sophisticated methods to investigate thinking in a foreign language.

The use of cloze as a reliable test of comprehension must be criticized on the basis of this study, because students seem to understand much more than correct replacements to blanks suggest. Also, it is not quite clear if only language proficiency is measured when students are asked to fill in gaps on the basis of a mutilated version of the text. Firstly, what is deleted may be so informative that it cannot logically be discovered. Then appropriate responses are only well-aimed guesses instead of sound inferencing on the basis of the language knowledge. What may, strictly speaking, be measured is partial redundancy, but this need not be equalized with language proficiency whether it is the mother tongue or a foreign language. Secondly, low correlations between items of the cloze test and the low percentage of their common variance explained by factors suggest that mutually inconsistent features of proficiency emerge in the performance of a cloze test. There will be no clear answer before the test and performance in it is scrutinized more thoroughly and by more inventive methods than merely correlating it with other language measurements or factorizing it over the items. It may be the case that we cannot actually speak of the cloze test as a fixed testing device in any other sense than as a model. The use of the cloze technique does not yield equal tests over the same text, let alone over different texts or different languages. The outcome cannot be predicted on the basis of what is deleted; at most on the basis of what is left. This, however, varies from discourse to discourse, and from text to text even in one language.

Although the text itself of the cloze test was easy for an advanced level, it is actually astonishing that it proved so difficult when only correct responses were counted. There may be various reasons. One of them is that pupils were not used to this type of test. It had occurred to some extent in Finnish schools but not as a regular device. Some of the pupils had never done it before. In principle, this difference should have no relevance to the problem of this study, because erroneous replacements were also interpreted. On the other hand, we may also assume that pupils' knowledge of English was so poor that they could not perform better. Without undue defence of Finnish pupils, experience shows that they usually perform better. The sample of pupils had been gathered from the population of the country, so that uneven performance was to be expected. But a perfect achievement was not possible either, so that relatively few scored higher than 40 points. Testing the corresponding language knowledge by other methods would very probably have yielded a better outcome. To give evidence for this is impossible but the conviction is based on experience.

In terms of teaching, cloze tests might be employed for practising communicative language. Since the knowledge of a foreign language cannot be repeated or reproduced mechanistically in the form it has been acquired, completing a cloze test encourages thinking and is sufficiently challenging as a task of using the foreign language in a meaningful way. It may, however, be somewhat frustrating or depressing as a testing vehichle in an unmodified form.

14. Some concluding remarks

In this study I have attempted to investigate thinking in a foreign language in order to answer the question of whether it is possible and in what sense. The problem was also intimately connected with a relation between language and thought. Although the question has been at issue for centuries and still is, this study took the functionalist theory as a starting point in order to avoid ontological problems. Likewise, it was possible to postulate higher-order mental processes independently of neurophysiology. The theoretical framework adopted for this study mainly originated from empirical research, which logically enabled us to find some empirical corroboration for the views developed in the present investigation.

The utilization of Johnson-Laird's theory of mental models clarified the distinction between the different types of representation. This was taken advantage of in elucidating how meaning is psychologically represented when the necessary and sufficient conditions were not considered adequate for characterization of meaning. In other words, intensions of words cannot be autonomous and their meaning and significance must be mentally represented in a way which goes beyond their linguistic forms. This is how Johnson-Laird's three-stage theory of comprehension came in handy to explain the comprehension of natural language.

Since actual thinking processes in the comprehension of language operate at the level of mental models, which do not encode linguistic material, we can claim that people think similarly in the process of comprehending discourse, whether it is in the native language or in a foreign language. Strictly speaking, it is not then possible to speak of thinking in a foreign language or any language at all. The language material is only used to construct such mental models which represent the significance of linguistic symbols. It was, however, assumed that distinctions made on the basis of perception in different cultures are also reflected in mental models. Therefore, the prototypes or schemata of meaning may cause people to construct mental models that slightly differ between speakers of different languages.

Although foreign language speakers have adopted some of the specifications and modifications of meaning in a particular language community, this knowledge is acquired, and its mastery is part of the automaticity required in the fluent use of the foreign language. Even in such a case a person thinks through those mental models that are outcomes of his mental development. Specified or modified distinctions made in the foreign language or distinctions lacking in the native language may become part of thinking as an outcome of learning, but thinking mainly takes place through more permanent mental models.

Our analysis showed that propositional thinking is thinking in pure meanings which are originally represented as a mother-tongue format. Inferencing from the foreign-language expressions thus leads to propositional thinking that is not fully independent of native-language meanings. The two types of representation show that so-called verbal thinking does not take place in words, or at the level of form, but through meanings of the language. But once the native language has been acquired, the meanings employed in thinking are influenced by its schemata. Therefore, the conclusion will be that there is no actual thinking in a foreign language, apart from those meanings that one does not have in one's own native language.

An interesting question may be raised as to how much of people's comprehension of a given discourse, either in the native language or a foreign language, is only seemingly correct. Since the ambiguousness and vagueness of linguistic expressions allow seemingly relevant responses and actions at the level of propositions, we can never be sure if people have really constructed correct mental models of the discourse. This can obviously be discovered only in the case of misunderstandings or if the person is clearly uncertain about the meaning of an utterance. A lot of communication can thus take place without either of the partners being aware of unclarities. Some symptoms of inexactness which did not much interfere with comprehension was found in the analysis of the cloze test responses.

The empirical study with the cloze test corroborated the theory of separate representations as well as the stages of comprehension in processing foreign-language discourse. In the cloze test pupils seemed to operate at the level of mental models and propositions and not to be focussing on linguistic forms and expressions. This tendency might be generalized to concern people's strategies in comprehension. They are inclined to think of the subject matter when they process language material, rather than of the linguistic forms and symbols through which thoughts are transmitted.

The results also showed a difference of good and poor performance between the two levels. It may then be concluded that the level that was reached depended on pupils' knowledge of the foreign language. Pupils tended to content themselves with the level of propositions if they had a deficient knowledge of English, but with a more profound knowledge of it, they were capable of constructing correct mental models of the given discourse. This is not a case of choice for pupils, but an indication of proficiency in the foreign language. I think this has implications for learning and teaching foreign languages as well.

What was said above of the suitability of the cloze test for encouragement to thinking applies specifically to practising a foreign language in general. For the construction of correct mental models through the foreign language pupils need practice in thinking in terms of the subject matter; otherwise they do not learn the significance of an utterance or discourse. Also, those meanings that must be specified or modified, with regard to a particular native language, must be learned for successful communication in a given foreign language. This is done in explicating the intensional and extensional meaning of words. Mere explanations do not guarantee proper learning if they are not applied to reading and listening to foreign-language texts and discourse as well as to producing thoughts in the foreign language. If it is automaticity in the use of a foreign language that is aimed at, tasks and practice that focus on the subject matter, and not on the linguistic forms, once they have been adopted, are likely to yield the best outcome in the form of automaticity. The question is of learning to express one's thoughts in the best possible way in a particular foreign language which, however, always restricts one's propositions from being as fully expressed as in one's own mother tongue.

The above suggestion does not imply that the linguistic forms should be neglected at the expense of communicating in a poor language. In learning a foreign language it is important to learn the forms of words and the rules that describe their use, but this is not enough. A lot of exercise is needed in the form of practice, but not in the form of drills. In using the foreign language, one often makes errors and mistakes, but they are likely to diminish gradually with practice, even though they are not corrected every time. More specific attention can be paid to the forms at other times. The reports of fossilizations of erroneous forms are based on the foreign language knowledge of people who do not receive regular lessons in the language, as is the case in school teaching.

If the finding that pupils mainly concentrate on the subject matter is true, it means that attention must be paid to the form of language and its function separately. Thus, for example, a lot of extensive reading of foreign-language texts does not necessarily improve the person's linguistic knowledge if he does not particularly focus on the language elements as well. In classroom conversation, foreign language teachers are capable of doing the dual task because of their interest in the language. Ordinary pupils act differently, and do not always notice the linguistic forms. On the other hand, teachers may neglect the subject matter in class in drawing excessive attention to the correct forms of the language. An optional state for teaching is perhaps achieved if the two tasks are mainly operated on at different times.

This investigation viewed thinking from the perspective of inferencing foreign-language discourse. Although it was mainly analyzed as a general phenomenon of cognitive psychology, comprehension of foreign-language discourse can be considered the most central aim of foreign language learning and teaching, because people want to learn to communicate in the particular foreign language. In terms of a thinking vehicle, a foreign language does not provide a learner with much richness, apart from certain interesting conceptual distinctions in meaning, but as a vehicle of communication, it opens up paths to new worlds and through them to different ideas and ways of thought which add to the richness of the cultural environment for the joy of human beings.

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CLOSE TEST APPENDIX 1.

Directions: (1) Read the whole passage through. (2) Then, go back and fill in the blanks with the words you think are missing. (3) Use only one word for each blank.

The other day, 1. SOME two or three days 2. AGO actually, I visited my 3. SISTER in hospital. She is 4. OLDER than I am: in 5. FACT she was almost grown-up 6. WHEN I was born. She 7. HAD had a minor operation 8. BUT was reported to have 9. LARGELY got over the after-10. EFFECTS of this. My wife suggested 11. MY taking her some flowers and 12. FRUIT but she said that I 13. NEED not take 14. HER any books as she 15. HERSELF had given her a 16. LOT earlier. This was my 17. FIRST visit so it took 18. ME several minutes to locate 19. THE ward she was 20. IN. 21. I always find hospital visiting 22. SOMETHING of an ordeal, and 23. AS I walked between the 24. ROWS of beds, I felt 25. VERY depressed, especially, at the 26. SIGHT of the lonely patients, 27. THOSE whose friends had not 28. TURNED up to chat with 29. THEM. My sister was half-sitting, half-30. LYING, propped up on pillows, 31. WITH a paperback detective story 32. IN her hand. She put 33. ASIDE the book, a little 34. RELUCTANTLY it seemed, thanked me 35. IN a rather half-hearted way 36. FOR the gifts and eyed 37. ME silently while I took a 38. SEAT on the hard 39. WOODEN chair by her bedside. 40. I commented on how 41. WELL she looked but she 42. IGNORED my remark. "Tell me," she 43. BURST out unexpectedly, "if you 44. WERE a doctor and wanted to 45. COMMIT a murder, 46. ONE of your patients, of course, how 47. WOULD you do it?"

Appendix 2. Some of the most typical errors in each item.

Item	f	Errors/ item	Item	f	Errors/ item
1.for	75	299	23.so	35	100
after	40		then	22	
2.before	36	158	24.queue(s)	78	298
in	32		line	29	
later	26		25.myself	91	256
after	21		me	46	
3.friend	21	35	a/little	39	
4.elder	104	114	26.place(s)	29	316
5.time	41	158	rooms	30	
6.before	15	30	(bed)side	21	
7.has	63	141	27.and	30	158
have	62		of	26	
8.which	201	306	patients	14	
that	53		28.came	35	229
9.been	70	286	got	22	
to	54		taken	17	
had	14		called	10	
already	13		30.sleeping	68	213
10.noon	35	299	laying	66	
wards	34		31.had	36	146
days	27		and	23	
operation	24		32.on	82	102
11.in	40	166	33.off	65	120
of	37		out	19	
to	31		on	16	
on	29		34.time	31	356
12.books	174	221	difficult	34	
13.would	73	169	while	28	
do	26		tired	16	
14.with	95	166	35.with	112	295
15.already	138	327	on	34	
had	42		for	35	
have	20		36.of	76	204
16.one(s)	45	223	about	39	
day	44		37.very	11	89
week	27		38.sit	50	179
little	21		chair	18	
18.a	49	164	39.arm	28	178
for	26		sitting	14	
19.right	16	109	41.good	53	165
where	17		42.noticed	47	265
20.lying	147	320	43.said	246	382
staying	25		44.are	57	119
22.out	26	237	45.make	78	240
like	19		be	58	
as	16		46.some	67	145
some	17		47.do/did	54	106

Appendix 3. Frequencies and percentages of the responses over the items on the cloze test and the variables constructed on the basis of the errors.

Variables: C - cloze test
M - mental models
P - propositions
I - incomprehensible
B - empty gap
E - double errors

Apart from E, all the categories are exclusive, making a total of 498. The percentages for E were counted out of the sum of models and propositions.

Item	Variables											
	C	M	P	I	B	C	M	P	I	B	E	
	f	f	f	f	f	%	%	%	%	% Total 100%	f	%
1.	288	87	59	26	38	57.9	17.5	11.8	5.2	7.6	11	7.5
2.	300	1	137	20	40	60.2	0.2	27.5	4.0	8.0	41	29.7
3.	460	0	34	1	3	92.4	0	6.8	0.2	0.6	1	2.9
4.	383	107	6	1	1	76.9	21.5	1.2	0.2	0.2	107	94.7
5.	255	4	100	54	85	51.2	0.8	20.1	10.8	17.1	31	29.8
6.	463	0	19	11	5	93.1	0	3.8	2.2	1.0	2	10.5
7.	335	129	11	1	22	67.3	0	2.2	0.2	4.4	136	97.1
8.	157	18	282	6	35	31.5	3.6	56.6	1.2	7.0	26	8.7
9.	44	0	256	30	168	8.8	0	51.4	6.0	33.7	170	66.4
10.	22	92	123	84	177	4.4	18.5	24.7	16.9	35.5	198	92.1
11.	320	3	161	2	12	64.3	0.6	32.3	0.4	2.4	157	95.7
12.	263	1	218	2	14	52.8	0.2	43.8	0.4	2.8	31	14.2
13.	304	4	185	0	5	61.0	0.8	37.1	0	1.0	92	48.7
14.	290	2	150	14	42	58.2	0.4	30.1	2.8	8.4	121	79.6
15.	43	3	301	23	128	8.6	0.6	60.4	4.6	25.7	128	42.1
16.	239	90	93	40	35	48.0	18.1	18.7	8.0	7.0	92	50.3
17.	482	6	0	8	2	96.8	1.2	0	1.6	0.4	3	50.0
18.	309	0	140	24	25	62.0	0	28.1	4.8	5.0	70	50.0
19.	351	34	45	30	38	70.5	6.8	9.0	6.0	7.6	44	55.7
20.	144	265	19	36	34	28.9	53.2	3.8	7.2	6.8	63	22.2
21.	482	0	0	8	8	96.8	0	0	1.6	1.6	0	0
22.	101	121	73	43	160	20.3	24.3	14.7	8.6	8.6	92	47.4
23.	373	1	76	23	25	74.9	0.2	15.3	4.6	0	0	0
24.	136	159	88	51	64	27.3	31.9	17.7	10.2	12.9	147	59.5
25.	234	52	186	18	8	47.0	10.4	37.3	3.6	1.6	55	23.1
26.	144	173	106	37	38	28.9	34.7	31.3	7.6	7.6	72	25.8
27.	177	47	80	31	163	35.5	9.4	16.1	6.2	32.7	90	70.9
28.	208	73	127	29	61	41.8	14.7	25.5	5.8	12.2	127	63.5
29.	438	7	0	36	17	88.0	1.4	0	7.2	3.4	4	57.1
30.	245	70	104	39	40	49.2	14.1	20.9	7.8	8.0	76	43.7
31.	315	113	14	19	37	63.3	22.7	2.8	3.8	7.4	47	37.0
32.	391	89	1	12	5	78.5	17.9	0.2	2.4	1.0	89	98.9
33.	364	109	3	8	14	73.1	21.9	6.0	1.6	2.8	24	21.4
34.	39	1	305	50	103	7.8	0.2	61.2	10.0	20.7	254	83.0
35.	160	240	34	21	43	32.1	48.2	6.8	8.6	8.6	239	87.2
36.	246	158	19	27	48	49.4	31.7	3.8	5.4	9.6	158	89.3
37.	376	0	40	49	33	75.5	0	8.0	9.8	6.6	8	20.0
38.	172	81	71	27	147	34.5	16.3	14.3	5.4	29.5	28	18.4
39.	161	18	94	66	159	32.3	3.6	18.9	13.3	31.9	12	10.7
40.	455	0	0	28	15	91.4	0	0	5.6	3.0	0	0
41.	288	75	63	27	45	57.8	15.1	12.7	5.4	9.0	71	51.4
42.	112	54	41	170	121	22.5	10.8	8.2	34.1	24.3	70	73.7
43.	88	330	0	52	28	17.7	66.3	0	10.4	5.6	302	91.5
44.	373	78	0	41	6	74.9	15.7	0	8.2	1.2	66	84.6
45.	247	149	57	34	11	49.6	29.9	11.4	6.8	2.2	63	30.6
46.	318	73	25	47	35	63.9	14.7	5.0	9.4	7.0	11	11.2
47.	386	85	18	3	6	77.5	17.1	3.6	0.6	1.2	90	87.4
Total	12421	3202	3964	1409	2349	53.1	13.7	16.9	6.0	10.0	3689	51.5

Appendix 4. A factor analysis for the cloze test with a principal axes model (six factors) and a varimax solution (four factors).

Variable	Principal axes model						Varimax solution				
	Factors										
	I	II	III	IV	V	VI	I	II	III	IV	h^2
1	.15	.02	.18	.25	-.19	-.13	.08	-.07	-.07	.32	.12
2	.31	-.17	.16	.21	-.13	-.08	.26	-.11	.10	.32	.19
3	.23	.21	.19	-.06	-.16	-.00	.17	.25	-.14	.17	.14
4	.11	.12	-.09	.13	.10	-.02	-.09	.09	.08	.16	.05
5	.36	.02	-.15	-.11	.02	-.04	.16	.25	.26	.08	.16
6	.14	.13	-.17	-.13	-.06	-.24	-.02	.25	.13	-.04	.08
7	.32	-.05	-.01	-.01	.18	-.17	.20	.11	.17	.14	.10
8	.35	.03	-.29	.18	-.13	-.03	-.05	.15	.38	.26	.24
9	.28	-.15	-.23	-.05	-.20	-.07	.12	.08	.36	.02	.15
10	.28	-.18	-.31	-.01	-.15	-.03	.07	.06	.44	.02	.20
11	.19	.07	.05	-.14	-.24	.07	.16	.20	.01	.02	.07
12	.38	-.11	.01	-.25	-.00	-.01	.37	.20	.20	-.02	.22
13	.46	.01	.07	-.06	.01	-.18	.32	.22	.14	.21	.22
14	.32	.11	.01	-.05	.04	-.14	.16	.24	.08	.15	.12
15	.21	-.01	.05	-.08	.00	-.13	.18	.11	.05	.06	.05
16	.32	-.27	.07	-.11	-.06	-.04	.39	-.03	.21	.03	.19
17	.23	.22	-.12	-.19	.15	.10	.05	.38	.09	-.00	.15
18	.43	-.00	.12	-.04	-.05	-.12	.33	.19	.10	.22	.20
19	.53	.10	-.09	.06	.16	.06	.19	.29	.27	.32	.30
20	.33	-.10	-.26	.10	.07	.10	.05	.08	.40	.17	.20
21	.21	.34	-.02	-.01	-.16	-.09	-.04	.36	-.04	.18	.16
22	.34	-.11	.12	.03	.06	-.06	.30	.04	.11	.20	.15
23	.40	.16	.04	.09	-.03	-.20	.14	.25	.08	.32	.19
24	.41	-.13	.10	.05	.01	.11	.33	.04	.17	.24	.20
25	.35	-.10	-.07	-.03	.04	-.09	.22	.11	.25	.12	.14
26	.35	-.16	.04	.03	-.17	.12	.29	.01	.20	.17	.15
27	.31	.11	-.15	-.10	-.05	.04	.09	.29	.20	.07	.14
28	.30	-.03	.08	.14	.03	.22	.17	.03	.09	.28	.12
29	.43	.32	.03	.06	-.10	.05	.10	.40	.03	.35	.29
30	.30	.03	.11	-.09	.11	.01	.25	.17	.03	.12	.11
31	.39	.10	-.03	-.06	-.02	.17	.19	.28	.16	.18	.17
32	.32	.01	-.07	.13	-.05	-.10	.09	.10	.20	.26	.13
33	.37	.04	.01	.23	-.16	.15	.11	.08	.15	.39	.19
34	.27	-.27	-.11	.01	-.02	.01	.21	-.06	.32	.06	.15
35	.42	-.03	-.07	-.06	.13	-.04	.24	.20	.25	.15	.18
36	.50	.03	.05	-.07	.24	-.03	.33	.27	.17	.22	.25
37	.32	.10	.19	-.10	.02	-.03	.29	.23	-.06	.16	.16
38	.31	-.18	.28	-.14	-.02	.13	.47	.02	-.01	.07	.23
39	.42	-.18	.13	-.17	-.08	.08	.46	.11	.16	.08	.25
40	.17	.17	-.09	.15	-.10	.11	.03	.29	.06	-.01	.09
41	.34	.11	.08	-.19	-.08	.04	.26	.30	.03	.07	.17
42	.51	-.13	-.05	-.03	.01	-.01	.33	.15	.32	.20	.28
43	.35	-.16	.01	.09	.15	-.13	.24	-.01	.22	.22	.16
44	.48	.12	.07	.16	.16	.15	.19	.22	.12	.42	.27
45	.26	-.05	-.02	.08	-.04	.09	.13	.05	.16	.18	.08
46	.26	.01	-.15	-.06	.04	.24	.09	.18	.23	.06	.09
47	.53	.13	.06	.26	.10	.01	.18	.20	.15	.53	.37
Eigenvalue	5.58	.93	.78	.71	.59	.57	2.40	1.80	1.77	2.04	8.01
Percentage variance							5.1	3.8	3.8	4.3	17.0

Appendix 5. Means and standard deviations of the sum variables, constructed on the basis of the highest factor loadings, in the different types of representation among the quartiles.

Factors / Types of representation		Quartiles						Total	
		Lowest		Interq.		Highest			
		$\bar{X}$	s	$\bar{X}$	s	$\bar{X}$	s	$\bar{\bar{X}}$	s
Ia	cloze	1.1	.9	2.3	1.1	3.9	.9	2.4	1.4
	models	1.9	1.2	3.2	1.1	4.4	.8	3.2	1.3
	propositions	2.6	1.0	3.4	.9	4.3	.7	3.4	1.0
Ib	cloze	.6	.8	1.5	1.1	3.2	1.3	1.7	1.4
	models	1.1	1.0	2.2	1.3	3.9	1.0	2.3	1.5
	propositions	1.9	1.1	2.6	1.1	3.9	1.0	2.7	1.3
III	cloze	.3	.5	.8	.9	2.3	1.4	1.0	1.2
	models	.8	.7	1.8	1.0	3.3	1.3	1.9	1.3
	propositions	2.4	1.2	2.9	1.3	4.2	1.1	3.1	1.4
IV	cloze	3.5	1.6	6.1	1.3	7.3	.8	5.8	1.9
	models	4.9	1.6	6.8	1.0	7.6	.6	6.6	1.5
	propositions	4.6	1.6	6.7	1.1	7.6	.6	6.4	1.5

Appendix 6. Distributions of some of the errors that indicate mother-tongue influence.

Item	Quartiles				Total
	Lowest	Interq.	Highest		% out of all errors per item
	f	f	f	cumul. f	
13.would	16	50	7	73	38.6
could	9	4	1	14	7.4
14.with	23	57	15	95	57.6
16.week,day,month, little	18	70	9	97	43.7
18.for	5	19	2	26	15.7
24.queues, queue	7	54	17	78	26.1
25.myself	33	45	13	91	35.7
20.lying	23	98	26	147	45.9
staying	1	16	8	25	11.8
33.off	15	43	7	65	18.3
36.about	8	26	5	39	21.8
of	20	44	12	76	42.5
Total f	178	526	122	826	9.6
%	21.5	56.8	14.8	100	

22. Sysiharju, Anna-Liisa. 1984. Women as educators: Employees of schools in Finland.

23. Gröhn, Terttu. 1984. Oppimisprosessi ja opiskelustrategiat korkeakoulutuksen kehittämisen lähtökohtana. Sovellutusalueena kotitalouden opetus. Tutkimussuunnitelma ja teoreettinen viitekehys.

24. Hautamäki, Airi. 1984. Lukioon lähtö ja sosiaaliluokka. 11—17 vuotiaiden nuorten itsesäätelyn ja ympäristöhallinnan kehitys kodin toimintaympäristön valossa.

25. Koskenniemi, Matti. 1984. Educational aims and the purposiveness of instruction. Sceptical talks.

26. Rikkinen, Hannele. 1984. Kuvien merkitys aluemaantieteellisen tekstin osana.

27. Nieminen, Seija. 1984. Teachers' perception of mental health, its relationship to their mental health and to changes thereof.

28. Lappalainen, Antti. 1985. Peruskoulun opetussuunnitelman syntyprosessi ja peruskouluopetuksen johtamisjärjestelmän muotoutuminen.

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